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THE MEASUREMENT OF HYSTERESIS.

The papers and discussion at the meeting of the American Institute of Electrical Engineers last week served to bring to the front the practical conditions which govern the measurement of magnetic hysteresis. It has been shown that this property can be measured with fairly good accuracy when proper precautions are taken and a precise laboratory method used. To meet these necessary conditions is, however, time-robbing, and the development of a satisfactory method for industrial use has been a problem. The Epstein method seems to have best met conditions generally found, but where it is necessary to make a large number of determinations in a short time, such a method as that described by Mr. Robinson is decidedly superior for the workshop. It gives comparative values with sufficient accuracy and has the advantage of using less time and material.

It is highly desirable that some method suitable for commercial conditions should be standardized in this country, for the convenience of manufacturers and buyers. The American Institute of Electrical Engineers could well take the initiative in this matter, as has been done by its sister society in Germany. There the Epstein method has been adopted and seems to give general satisfaction, the standard test being at fifty cycles and 10,000 gausses. Perhaps the details of the Epstein method could be revised so as to be more acceptable in this country, but its predominant features should be retained for a standard comparison method. Where shop conditions make other methods desirable, they can of course be used, the standard method being resorted to only for occasional comparisons, and to check up results against those obtained by outside parties. The more accurate methods available by the use of properly proportioned rings or such apparatus as that in vogue at the Bureau of Standards are more especially suitable to investigations aimed at a correct value of the physical constants, and similar tests where accuracy is more important than economy in time, in materials or in the necessary apparatus. It is important, however, that any method adopted as a commercial standard should use a specimen of such dimensions that the hardening effect of the cut edges is small, since it is not always feasible to anneal after cutting, and indeed, unless annealing can also be standardized (a difficult matter), results obtained by different observers at different places would

not be comparable. It is well recognized that the process of annealing is quite as important a factor in determining the properties of the material as any other factor involved.

The paper by Professor MacLaren is of great interest in showing the manner in which hysteresis varies with temperature. Caution must be observed, however, in attaching too much weight to the accuracy of his measurements. When the form-factor is not determined in the wattmeter method, too much dependence should not be attached to the numerical values. Moreover, the values given by Professor MacLaren for the exponents which represent the power of flux density which is proportional to the hysteresis, are very misleading. A cursory inspection of the paper would indicate that these values are close to 1.6 throughout, whereas in fact they vary enormously from this value, as hinted by Mr. Wooldridge in the discussion. This is partly due to the *assumption* of the value 1.6 at low flux densities and partly to the method of computation, which has been unfortunately selected. For the silicon-steel, for instance, the exponents go as high as 1.79 and down to a value less than unity. Taking the values at 659 degrees centigrade for 8,000 and 10,000 gausses, the values of hysteresis are seen to be 0.057 and 0.064. That is, while the flux density has increased 25 per cent, the hysteresis loss has increased only 12.5 per cent. The hysteresis is here increasing less rapidly than the flux density, and the exponent has a value of only 0.52. Evidently the relations change radically at this high temperature, or else the measurements are greatly in error.

It is sometimes wondered by those designing and testing electric machinery that the values for the exponents of flux density which are found in laboratory experiments or computed on theoretical grounds, do not apply in practice. It would really be more wonderful if they did. Such an exponent as 2.0 for eddy currents, for instance, is computed on the assumption of uniform flux density in one definite direction in a sheet of infinite width. In dynamo and motor cores none of these conditions are fulfilled, and even in transformer cores we do not have uniform flux density. The demagnetizing effect of the eddy currents makes the flux less at the center than near the surface. With increasing flux density or increasing frequency this effect is intensified and results in the eddy currents increasing at a less rate than the square of either of these quantities. As shown in Mr. Wooldridge's paper at the recent Schenectady convention, the exponent for eddy current is actually found to decrease with increasing flux density, and such a decrease is qualitatively explained by this fact. It must be remembered, however, in connection with the determination of eddy-current losses, especially in silicon-steel, that they form a small part of the total loss, and accurate determinations are extremely difficult. Small errors in observation, or small departures in the wave form, may produce large errors in the value of exponent found.

In the cores of generators and motors, the flux density does not simply alternate in direction, and the relative distribution of flux is not constant. The flux pulsates in space as well as time. The laws of hysteresis and eddy-current loss which obtain with the usual testing apparatus, cannot be expected to apply even approximately under such conditions.

It is interesting to observe that the method used by Professor MacLaren in which a constant secondary voltage is maintained by a uniform variation of the flux can be used with small samples, as it has been usually supposed that this only applied to cases in which the cross-section of the material, and consequently the flux, was enormous. It would seem necessary in obtaining intermediate points on the hysteresis curve by this method, to make some allowance for eddy currents, whose effect is to alter the instantaneous magnetizing field.

THE TRACKLESS TROLLEY.

The recent announcement of a trackless trolley company which has been incorporated in West Virginia, and reports of one already in operation in California, point out a way to transportation development in many places where it is an impossibility with the ordinary type of railway car.

A number of such lines are in operation in the cities of Continental Europe, and while our highways have not in general attained such development as have the roads of older countries, there are many roads in our rural districts which are smooth enough and are kept in dry enough condition to permit of the successful operation of trackless cars in all seasons.

While it is not possible that a car traveling on a wagon road could keep such a schedule as is at present attainable on modern interurban trolley lines, this high speed is not an absolute necessity nor would it be demanded for local service. Farming communities could be served by cars radiating from market centers and if a regular service were given the lines could hardly fail to attain considerable popularity. In many cases it would surely be a gain both in reliability of operation and in economy over the gasoline-driven motor busses which are used for carrying passengers in some districts.

Such a system of trackless cars, nevertheless, has its limitations and there is no doubt that where traffic is exceedingly meager the self-propelled carriage would be the cheapest method of locomotion. There is a region of greater density of traffic to which it is especially applicable. In this field the traffic, while hardly dense enough to warrant the laying of rails, would require the operation of enough omnibusses to warrant the installation of a central power plant. Maintenance charges on a central power system would be very small as compared to the cost of upkeep for an equal number of self-propelled cars.

INCREASING THE EFFICIENCY OF A LARGE GAS-ENGINE PLANT.

The introduction of new sources of motive power in plants not having experience with highly specialized types of generating equipment usually involves a long period of adjustment before the maximum effectiveness of the installation can be attained. Certain gas-engine installations illustrate this point to a marked extent, as is shown in a paper upon the elimination of some sources of loss in a large producer-gas-engine plant read by Mr. John G. Callan before the recent Congress of Technology at Boston. In the case in hand the output of a large mill was absolutely limited, not by the commercial market, but by the available power which could be generated in a plant consisting of four tandem, double-acting producer-gas engines driving 810-kilowatt, three-phase, 440-volt, twenty-five-cycle generators at 107 revolutions per minute. The generators operated in parallel, delivering power to a mill having a substantially steady load, the power-factor being about eighty per cent. Gas was furnished by three down-draft producers connected to a 30,000-cubic-foot holder, and the fuel consisted of a lignite having a heating value of 7,600 British thermal units, carrying about thirty-four per cent of moisture, and eight per cent of ash. The failure of the plant to deliver its rated power caused a direct money loss of considerable magnitude.

The plant was subjected to an exhaustive test covering nearly a month with the object of increasing both its output and efficiency. The engines gave serious trouble from back-firing, and to avoid this, throttles had been placed in the air lines to cut down the flow of air to a point below which the rate of propagation of the flame in the mixture was a maximum. This expedient stopped the back-firing, but was extremely wasteful of gas. After a long investigation it was found that the pressure in the cylinder immediately after the opening of the exhaust valve remained above that of the atmosphere for a certain fraction of the exhaust stroke. For the remainder of the exhaust stroke it was found that the back-pressure became negative. In other words, during a portion of the exhaust stroke, varying with the load from the last two-thirds to the last half, there was a slight vacuum in the cylinder instead of the positive back-pressure anticipated. This was found to be due to the wave set up in the long straight exhaust pipe by the first vigorous puff at release. From this it immediately appeared that on the opening of the inlet valve explosive mixture began at once to enter the segregated valve chamber, even though the piston had not finished its exhaust stroke, and that this inflow became more vigorous as the valve opened further, the incoming mixture mingling with the exhaust and in part passing out with it through the exhaust valve. It appeared that the exhaust gases, aided by the heat of the walls, were hot enough to ignite the mixture flowing in at low velocity, mingling thoroughly with the hot gases and passing with them through a slightly separated valve and seat which had just been exposed to the hottest gases.

The operation of all the engines was ultimately changed as to both mixture and ignition point. The mixture was first set with a slight excess of air over the theoretical requirements, thus maintaining as complete and non-luminous combustion as possible, minimizing carbon deposit and keeping the valve chamber cooler and cleaner; and, second, the ignition was set materially earlier, thus enabling the engines to run on a pointed rather than a flat-topped indicator card, thereby reducing the temperature of the gas at the moment of release. After a short time marked improvement in operation became apparent, and while back-firing was not wholly eliminated, the conditions were much bettered. This procedure alone enabled the output of the engine to be increased in a marked degree, with a corresponding reduction in the amount of fuel consumed per kilowatt-hour, particularly when a slightly lean mixture of gas and air was employed. In this connection, analyses of the exhaust gases disclosed the interesting point that if samples were taken from a point a few feet below the top of the exhaust pipe, there was indicated a large excess of air in the mixture at a time when it was reasonably certain such excess did not exist. This was found to be due to the regurgitation of air into the exhaust pipe during the recession of the wave set up in the pipe by the puff occurring at release, as well as the loss of combustible mixture into the exhaust as already noted. With suitable changes in the firing practice it also became possible to secure during most of the twenty-four hours a fairly uniform quality of gas. The design of the producers was such that their operation was not continuous and during periods of cleaning this uniformity could not be well maintained, but at such periods engine adjustments were permitted if they appeared desirable.

On the whole the plant performance was improved about twenty per cent as a result of the tests. The major part of the improvement turned upon the fact that the engine would not of necessity give the same results upon a given valve setting and resulting indicator card as would an engine of different clearance and valve design, and on the further fact that the arrangement of exhaust piping employed produced a period of slight vacuum in the cylinders during the latter half of the exhaust stroke. The engines were somewhat handicapped by the use of a bottle-shaped valve chamber connected by a relatively narrow neck with the main clearance of the cylinder, the exhaust and inlet valves being less than a foot apart, the better practice being to separate such valves by the entire diameter of the cylinder. The increase in power output paid in a very short time for a test undertaken initially in connection with acceptance, and with no expectation of direct financial return.

ELECTRICAL JOBBERS GO EN MASSE TO CALIFORNIA.

SPECIAL TRAIN OF FOURTEEN CARS LEAVES CHICAGO, APRIL 18, WITH TWO HUNDRED PROMINENT JOBBERS AND MANUFACTURERS ABOARD.

On the evening of Tuesday, April 18, the "Electrical Supply Men and Jobbers' California Limited" left Chicago over the Santa Fe for Monterey, Cal. This marked the beginning of a trip and a series of meetings which will be completed on April 24, the executive sessions being held at Del Monte the latter part of the week. The train equipment included six standard sleepers, four compartment cars, an observation car, and three diners.

Brief stopovers will be made at several of the picturesque points enroute. A splendid program of entertainment has been provided under the direction of H. H. Cudmore, chairman of the entertainment committee. Mr. Cudmore has provided in a most remarkable way for the edification and entertainment of his guests and the observation car was well stocked with material for the playing of games of all kinds, with song-books including the choruses and score of over one hundred popular songs, and an illustrated booklet giving a synopsis of the card games, singing festivals, and the serious sessions of the trip.

A feature of the journey was the publication of a daily newspaper—"The Daily Shock." One edition was to be distributed at Kansas City, on Wednesday, April 19; another at Albuquerque, New Mexico, on Thursday morning, April 20; and another at Grand Canyon, Arizona, on Friday morning, April 21. This newspaper is quite an innovation, is full of interesting personal notes and trade comments, and contains also a serial story. There is a series of "Mutt and Jeff" cartoons, depicting the experiences of these notable characters at the Jobbers' meeting at Del Monte, which are highly amusing. This newspaper has been published under the personal direction and was largely prepared by Mr. Cudmore.

A novelty which attracted a great deal of attention was a "Mazdalin," exhibited and demonstrated by J. Robert Crouse. The first, second and third (G D A) strings used on this instrument, which is of the general type of mandolin, are made from genuine drawn tungsten wires, as used in the latest Mazda lamps. The fourth (E) string of the "mazdalin" is made from molybdenum wire used in some cases for filament supports. The strings used upon an ordinary mandolin, from which this instrument is copied, are made usually from steel wire.

This interesting and novel experiment shows what a great tensile strength and ruggedness have been developed in the filament used in the latest types of Mazda incandescent lamps. Drawn wire of these metals was not known to metallurgy until developed for lamp manufacture. In the sixty-watt Mazda lamp the drawn wire shows a tensile strength of 500,000 pounds per square inch, and it is planned while enroute to demonstrate the ruggedness of this wire by lifting chairs and performing other unbelievable stunts. This innovation in the use of tungsten wire was suggested by A. D. Page, of the General Electric Company, and executed by T. W. Frech, J. Robert Crouse and C. C. Gale, of the National Electric Lamp Association, in the lamp development laboratory of the National Association.

The train left Chicago promptly at 8:00 p. m. and the departure was witnessed by a host of prominent electrical people. Among those in attendance were the following:

Mr. and Mrs. H. S. Sands, Mr. and Mrs. F. T. Andrae, Mr. and Mrs. E. W. Rockafellow, H. W. Bliven, Mr. and Mrs. W. A. Fullerton, Mr. and Mrs. C. E. Corrigan, Mr. and Mrs. W. M. Merrill, Mr. and Mrs. F. S. Price, Mr. and Mrs. C. C. Sibley, Mr. and Mrs. W. W. Low, Mr. and Mrs. H. B. Scott, Mr. and Mrs. F. E. Stowe, Mr. and Mrs. C. W. Leveridge, Mr. and Mrs. G. N. Stuart, E. G. Bernard, J. Robert Crouse, Max McGraw, W. H. Sheldon, Jr., Mr. and Mrs. B. M. Downs, Mr. and Mrs. W. L. Adams, Mr. and Mrs. F. S. Hardy, Mr. and Mrs. J. E. Swisher, Mr. and Mrs. J. C. Gilchrist and the little Gilchrists, Mr. and Mrs. C. T. McKinstry, Mr. and Mrs. C. J. Litscher, Mr. and Mrs. W. T. McCullough, Mr. and Mrs. E. C. Graham, Mr. and Mrs. P. S. Klees, Mr. and Mrs. H. H. Cudmore, Mr. and Mrs. L. A. Schwab, Mr. and Mrs. C. E. Browne, Mr. and Mrs. Geo. R. Jones, Mr. and Mrs. J. A. Bennett, F. M. Bernardin, Gilbert S. Smith and little Smiths, R. C. Murdock, J. B. Terry, H. D. Betts, H. H. Hornsby, Jas. Clark, Jr., J. R. McNaughton, J. Binford, Jr., W. S. Bissel, C. H. Talmage, Mr. and Mrs. D. D. Dickey, Mr. and Mrs. C. F. White, T. J. O'Brien, W. N. Matthews, V. F. Gates, H. I. Sackett, John W. Brooks, V. Despard, E. A. Loomis, A. G. Munroe, F. E. Barrington, J. H. Parker, H. B. Crouse, A. H. Pease, W. M. Deming, F. N. Bover, L. V. Garron, N. C. Cotabish, F. R. Elliot, H. S. Wilson, W. A. Browne, N. G. Harvey, T. M. Debevoise, A. E. Williams, D. C. Hemingray, E. M. Scribner, Robt. Kuhn, A. H. Scranton, E. K. Patton, W. R. Herstein, Geo. E. Kellogg, J. D. Sweeney, E. L. Scott, A. C. Garrison, Mr. and Mrs. P. M. Fletcher, Mr. and Mrs. G. L. Patterson, C. I. Hills, G. F. Morrison, F. S. Terry, B. G. Tremaine, Walter Cary, L. W. Kittman, F. Overbagh (general secretary), Mr. and Mrs. A. D. Page, Mr. and Mrs. J. G. Pomeroy and Miss Kathleen Pomeroy, Mr. and Mrs. T. C. Ringgold and James B. Olson.

Hotel Arrangements for N. E. L. A. Convention.

The Hotel Committee of the National Electric Light Association, of which Frank W. Smith is chairman, is taking the active initiative as to convention work by issuing this week a circular with regard to hotel provision for the convention at the United Engineering Societies Building in New York City, May 29 to June 2. The circular of the Committee is quite an elaborate piece of work and includes a list of fifty-four hotels with their location, telephone number and the fullest details as to accommodations and prices. In addition to this, the circular, which bears on the outside an admirable vignette of the Engineering Building, embodies also a colored outline map of Manhattan Island, showing the location of the Building and of every one of the hotels listed, so that the members can see at a glance the relative distance, convenience, etc., of all the available accommodations.

The map includes lines of elevated railroad and subway with the stations indicated. As an attendance of 3,500 is now expected and virtually assured, Mr. Smith is anxious that all who intend to be present will avail themselves of the data thus furnished and will return to him the reply postal card which will enable the appropriate reservations to be made.

Thomas D. Lockwood.

The electrical industry, and peculiarly the department of telephony and telegraphy, has afforded many examples of men who, self-taught, have achieved great reputations and established themselves as valuable members of great organizations. A conspicuous example of natural genius is Thomas Dixon Lockwood, the subject of this sketch.

Mr. Lockwood was born at Smethwick, Staffordshire, England, on December 30, 1848, the son of John F. and Mary (Dixon) Lockwood. He was educated in the common schools. His entrance into the electrical industry was some time in 1866 or 1867, when he learned and practiced telegraphy in Canada. Later on, in 1868 and 1869, we find him interested in the manufacture of paper at Lee, Mass., and in 1869 and 1871 he was engaged in the manufacture of plate glass. He worked as a telegraph operator and ticket agent, and also as an engineer on railroads in Connecticut and New Jersey from 1871 to 1878. Since July, 1879, he has been associated with the Bell Telephone interests. From 1879 to 1881, he was assistant general inspector of the National Bell Telephone Company, and since 1881 he has been electrical engineer in charge of the patent department of the American Bell Telephone Company. He was advisory electrician and engineer of the Bell Telephone Company of Canada from 1880 to 1890, and since 1882 has been advisory expert of the Western Electric Company. He has also been expert manager of the patent and technical information department of the American Bell Telephone Company since 1881. He is now manager of the patent department of the American Telephone & Telegraph Company with headquarters at Boston. He is a consulting professor of telephony, telegraphy and patent practice at the Brooklyn Polytechnic Institute. He is a patent solicitor and expert in electrical inventions before the Patent Office and in the United States Courts. He is an authority on telephony and telegraphy.

Mr. Lockwood is a member of the Institution of Electrical Engineers of Great Britain, a foreign life fellow of the Imperial Institution of London, a life member of the American Institute of Electrical Engineers, an honorary member of the National Electrical Light Association, an honorary member of the Association of Railway Telegraph Superintendents, and a member of the Canadian Electrical Association. He has been a liberal contributor to the technical press, and is the author of "Information for Telephonists," 1881; "Electrical Measurements," 1883; "Electricity, Magnetism and Electric Telegraph," 1885; and "Translation and Revision of Ohm's Law," 1890.

THOMAS D. LOCKWOOD,
Manager Patent Department, American Telephone & Telegraph Company.

Wireless in Peru.

Peru has long possessed an overland wireless telegraph system in constant commercial and Governmental use, between Iquitos on the Amazon and Puerto Bermudez on the River Pichis, the terminals being about 500 miles apart, separated over much of the distance by an impenetrable tropical jungle. Puerto Bermudez is over 100 miles from Oroya, and in the direct line from that terminus of the Central Railway to the Amazon, via Tarma and La Merced. The air-line distance from Lima to Iquitos is about 700 miles, both terminals being less than 600 feet above the sea, and the lowest part of the intervening Andes range being over 15,000 feet. The working of a new station erected on the Cerro San Cristobal, Lima, is being watched with interest by the scientific world.—*Peru of Today.*

Reduction in Electric Light and Gas Rates in Chicago.

The Commonwealth Edison Company has publicly announced that on May 1 it will reduce the rates of its electric-light patrons. On all bills computed from meter readings taken on and after that date, the net charge for the primary, or maximum, portion will be reduced from twelve to eleven cents per kilowatt-hour. The secondary, or low-rate, portion will remain at six cents net per kilowatt-hour. This reduction is entirely voluntary and will mean a saving of about $350,000 annually to the consumers affected, who are chiefly the small patrons in the residence districts.

On March 30, 1908, a contract fixing a schedule of rates until July 31, 1912, was concluded between the Company and the City of Chicago. On August 1, 1909, a reduction in rates was made according to this contract. The present voluntary reduction, which is equivalent to about five per cent, brings the total reduction in residential rates since June, 1905, to approximately forty-three per cent.

In marked contrast to the voluntary reduction announced by the Commonwealth Edison Company, is the attitude assumed by the Peoples Gas Light & Coke Company, of Chicago, regarding the proposed reduction in rates for gas. The present net gas rate of

eighty-five cents per 1,000 cubic feet was established by a contract between this company and the city which expired February 28 last. The City Council engaged the services of W. J. Hagenah to make a complete report on the company's plant and business and to recommend a rate that will be equitable to both the company and its consumers. This report, which has just been made public, recommends a reduction to seventy-seven cents and states that this will still permit a seven-per-cent dividend and an annual reserve for depreciation and contingencies. The company contends, on the one hand, that the proposed rate would be ruinous; on the other hand, the new city administration, which made seventy-cent gas one of its pre-election promises, adheres to the demand that the rate be seventy cents, or even lower. The probable outcome will be a prolonged contest in the courts and the making of the gas-rate problem into a political football.

American Institute Convention.

The American Institute of Electrical Engineers will hold a convention at the Alexandria Hotel, Los Angeles, Cal., from April 25 to 29. Sessions for the reading of papers will be held on Tuesday, Wednesday and Thursday. Following Tuesday's meeting, there will be a trip over the Los Angeles Pacific lines, *via* Hollywood, the Palisades, and on to Redondo Beach, where the great power house of the Pacific Light and Power Company will be inspected. Dinner will be served at the beach, and opportunity will be afforded the visitors for a dip in the ocean. On Thursday afternoon, there will be an automobile trip through the suburbs of Los Angeles, ending with luncheon at Casa Verdugo. Other entertainments are being provided.

The following papers will be read at the various sessions of the convention: "Transmission Applied to Irrigation," by O. H. Ensign and J. M. Gaylord; "Cisoidal Oscillations," by G. A. Campbell; "Continuity of Service in Transmission Systems," by M. T. Crawford; "New Automatic Telephone Equipment," by Charles S. Winston; "Auto-Manual Telephone Systems," by Edward E. Clement; "Some Recent Developments in Railway Telephony," by Gregory Brown; "Electricity in the Lumber Industry," by E. J. Barry; "The Refining of Iron and Steel by Induction-Type Furnaces," by C. F. Elwell; "Transmission Systems from the Operating Standpoint," by R. J. C. Wood; "A Power Diagram Indicator for High-Tension Circuits," by Harris J. Ryan.

New Telephone Exchange at Geneva.

A new telephone exchange has been installed at Geneva, Switzerland. An old magneto switchboard has been replaced by a central-battery system installed by the Bell Telephone Manufacturing Company of Antwerp, one of the European houses of the Western Electric Company.

Switzerland is one of the best telephoned countries of Europe. Here, as in other foreign lands, the telephone is operated under government ownership. On the foundations of the old post office in the Rue de Strand a large structure has been erected to house the offices and operating rooms of both the telegraph and telephone systems. The room which contains the switchboard is about sixty-five feet in length and half as wide. The ceiling, in the shape of an arch, measures twenty-one feet above the floor at its highest point.

This board has a capacity of 12,000 lines and is at present equipped for 7,000. There are 6,300 subscribers, who make an average of 22,000 calls a day.

The first common-battery telephone system in Switzerland was installed at Berne in 1908. The success of the installation in the capital has led to the adoption of the up-to-date method in the new Geneva building.

The exchange contains ten sections for subscribers' service, another section for service to suburban villages, a toll section, together with information, chief operator's and wire chief's desk. The wires from the subscribers' sets are carried into the exchange by means of underground cables.

Transportation for N. E. L. A. Convention.

In connection with the "Electric Light Special" train from Chicago to New York for the convention of the National Electric Light Association, transportation for members coming from the West will be arranged for by E. J. Bowers, assistant master of transportation, 1500 Grand Avenue, Kansas City, Mo.

Special train service will be arranged from Kansas City, connecting at Chicago with the Electric Light Special. All members traveling from or through Kansas City are requested to correspond with Mr. Bowers, who will arrange for reservations and party tickets.

Entertainment Committee for Convention of N. E. L. A.

The following sub-committees of the Entertainment Committee have been appointed for the convention of the National Electric Light Association:

Monday Evening Reception.—Frank W. Smith, chairman; C. W. Price, H. M. Wilson, C. H. Macy, H. F. McGowan, T. Beran.

Public Policy Meeting.—W. W. Freeman, chairman, T. C. Martin.

Theater.—C. G. M. Thomas, chairman; C. H. Macy, E. H. Rosenquest, G. F. Parker, Stewart Wilder.

Ladies' Entertainment. — Dudley Farrand, chairman; Gano Dunn, L. A. Coleman, J. E. Phillips.

Golf.—H. M. Edwards, chairman; H. L. Snyder.

Baseball.—H. F. McGowan, chairman; J. C. Bates, J. E. Phillips.

Visit to Coney Island.—W. F. Wells, chairman; J. C. Bates, C. H. Macy, G. F. Parker.

High-Pressure Pumping Stations.—J. E. Phillips, chairman; A. S. Rugg, E. H. Rosenquest, A. A. Brown.

Automobile Trip.—F. C. Bates, chairman; E. H. Rosenquest, F. A. Stratton, H. M. Wilson.

The committee is to provide for chaperons and shopping guides, public stenographic work, and a guide to New York.

Political Speech by Telephone.

A speech delivered by Congressman Edward W. Townsend at Washington was transmitted by long-distance telephone to twenty-five hearers at the home of Union N. Bethel, Montclair, N. J. The members of the Cliff Dwellers' Club, of which Mr. Bethel and Mr. Townsend are both members, were thus entertained by a speech transmitted through a distance of 225 miles.

Telephone Pole Preservation.

It has been proved that a thorough soaking in sea water lengthens the lives of telegraph poles. Some poles soaked during the winter of 1908 are found to be quite sound. The process is somewhat lengthy, but the results appear to be quite satisfactory.—*Electrical Engineer.*

Reconstruction of the Rockford Central Station.

Complete Rebuilding Without Interruption of Service.

To change an electric power plant from the design and practice prevailing twenty years ago to the design and methods of today is in itself a task of no small difficulty, but to make this change without interrupting the service for even a day is a still more difficult undertaking. This is the problem that confronted the American Gas & Electric Company, soon after it purchased the old plant of the Rockford Edison Company, of Rockford, Ill., in 1907. The chief work in the reconstruction of the plant was begun early in 1910, although a number of changes had been made in 1908 and 1909. The entire rebuilding will probably be successfully completed in the spring of this year. To a person familiar with the arrangement and appearance of the old plant, the completed power house will look like an entirely new station, despite the fact that it is on identically the same site, somewhat enlarged.

When the franchise and property of the old company were acquired by the present owners, it was realized that the conditions in Rockford were favorable to the development of a heavy central-station load. The excellent location of the city along both sides of the Rock River with its water power brought many large mills and an industrious class of employees to it years ago. As a result, Rockford has become a thriving and progressive manufacturing community with a population of 45,401, according to the 1910 census, this being an increase of forty-six per cent in the last decade. There are now in Rockford, nearly 400 industrial establishments employing about 14,000 persons on an aggregate annual payroll of over $7,000,000. Among these concerns are twenty-five furniture factories, seventeen machine shops, seven foundries, four great hosiery-knitting mills, five bent-glass and mirror works, four farm-implement factories, besides large shops for the manufacture of such varied products as gas stoves, gas engines, pianos, pumps, shoes, clothing, hardware, sewing machines, paper boxes, etc.

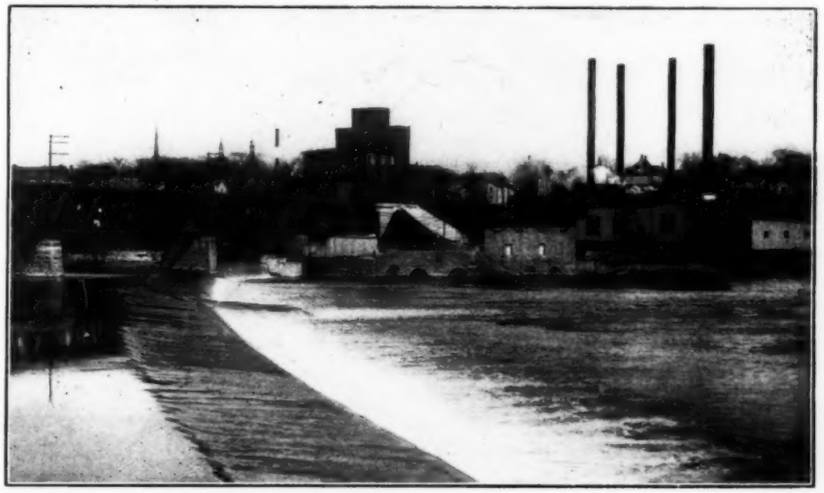


FIG. 1.—GENERAL VIEW OF OLD PLANT AND DAM.

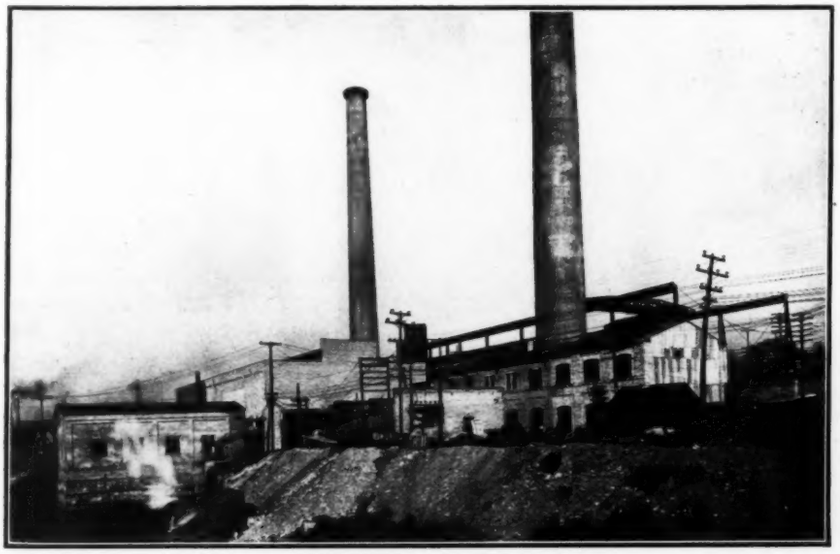


FIG. 2.—GENERAL VIEW OF NEW PLANT.

As the power requirements for these numerous factories rapidly increased beyond the available water power, isolated steam-driven plants had generally been installed. The supply of central-station electric power had not been strongly exploited, however, until in the fall of 1907 when the new owners of the property inaugurated an active development of the business in all directions.

Soon after the acquisition of the Rockford Edison Company, the American Gas & Electric Company bought the Central Heating & Power Company's property consisting of a 600-kilowatt electric and heating plant, and combined the two, changing the name to Rockford Electric Company, thus securing not only all of the commercial and residential lighting and power business, but also an exhaust-steam heating system in the main business district.

The street arc lighting had for some time been supplied from the old Rockford Edison plant, as also the power for the street-railway lines, the local railway company being indisposed to building and operating an independent power plant. The interests in control of the latter company acquired possession of all the interurban lines radiating from Rockford, including the Rockford, Beloit & Janesville Interurban Railway

with its power house at Beloit, Wis., containing 1,080 kilowatts of generating equipment. To obviate the operation of this remote plant, which would be the only power house on the electric railway system, it was leased to the Rockford Electric Company, which thereby secured still another class of load.

Of these two small auxiliary plants the central heating station has now for some years been operated only during the heating season. As coal must be hauled to it by wagon, this station will soon be entirely shut down and held only for emergency reserve. A twenty-inch exhaust-steam main has been laid from the main plant some 2,500 feet distant and across the river to serve the heating system. It was found also that the Beloit plant could not be operated as economically as the main station, so it also will be shut down except for emergency service.

Attention will now be directed to the main station. A conception of how the old plant looked from a distance is obtained from Fig. 1, in which the four steel stacks show its location adjoining the bridge of the Chicago & Northwestern Railway. The old wooden dam across the river is also conspicuous. In Fig. 2, which is from a photograph taken last October, is seen the rebuilt plant viewed from the southwest. Although the reconstruction was not entirely complete at the time this picture was obtained, it gives a good idea of the extent of the rebuilding work and of the business-like character of the undertaking and forms a striking contrast to the little station shown in Fig. 2.

Until the sale of the property in 1907, all the load was direct-current, supplied at 110-220 volts for lighting and power purposes, at 550 volts for the railway lines and as 6.6-ampere constant current for series arc street lighting. The generating equipment comprised a total of eighteen dynamos as follows: eight 110-volt Edison bipolars, one 220-volt multipolar, two 550-volt railway generators, and seven 125-light Brush arc machines. For driving this varied assortment there were seven sixty-two-inch water-wheels, two tandem compound, moderate speed, condensing engines of 1,200 and 600 horsepower, and two cross-compound, condensing, Corliss engines. The two latter were direct-connected to the 650 and 400-kilowatt railway generators and constituted the most modern part of the plant. The remainder of the generator equipment was belt-connected to two line shafts, each with an engine at the east end and a set of water wheels at the west, or river end. The general arrangement of all this equipment is well shown in the accompanying plat, Fig. 3, which also shows the additional equipment installed during the first year of the new regime to supply the rapidly growing load.

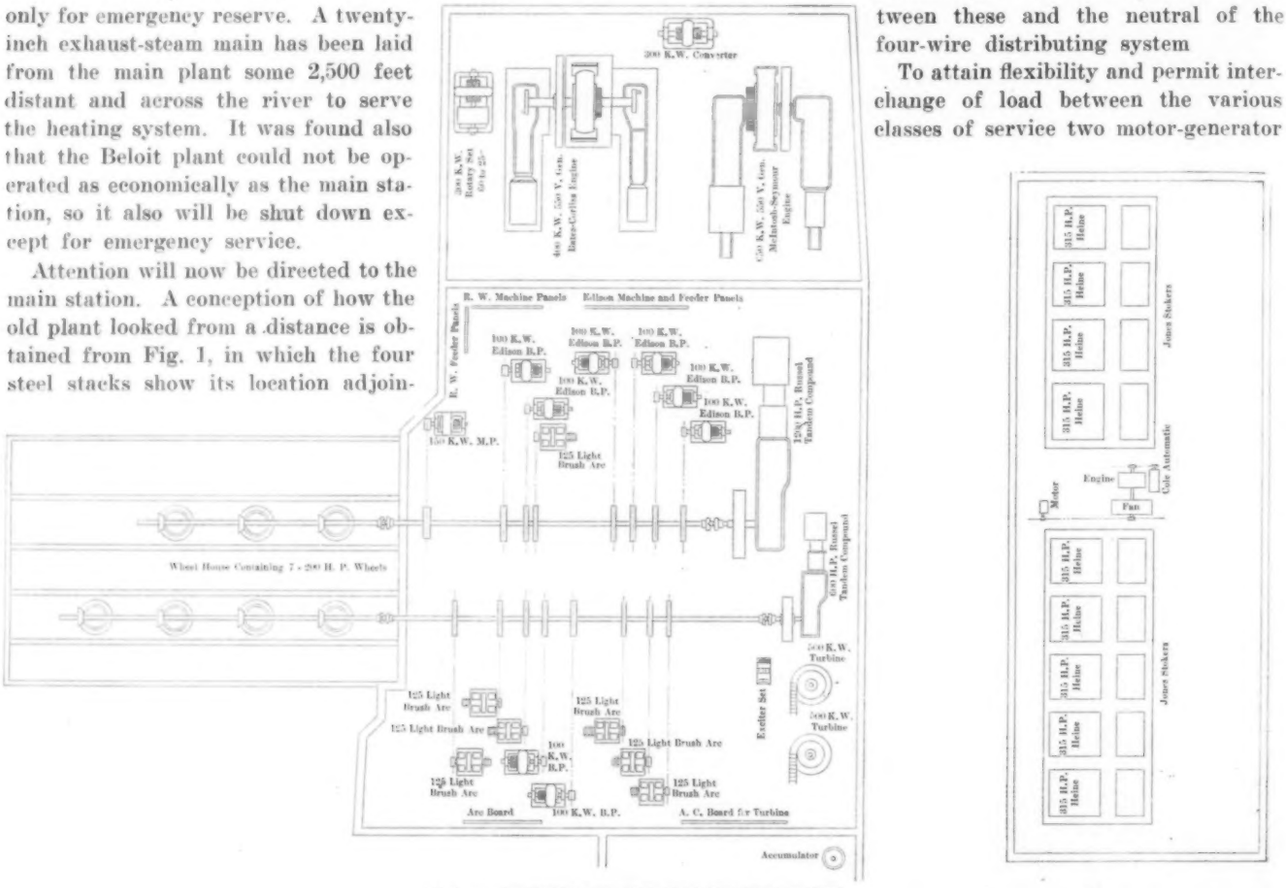


FIG. 3.—LAYOUT OF OLD ROCKFORD PLANT.

The extension of electric service to the residence districts was one of the first things undertaken by the new management. For this purpose alternating-current distribution was naturally chosen and there were installed two Curtis vertical turbo-generators of 500 kilowatts capacity each. These generated three-phase, sixty-cycle current at 4,000 volts between the Y-connected lead wires and 2,300 volts between these and the neutral of the four-wire distributing system

To attain flexibility and permit interchange of load between the various classes of service two motor-generator sets were installed. One of these consisted of a 530-kilowatt synchronous motor driving two 250-kilowatt, 250-volt, direct-current generators. Thus the sixty-cycle system could feed into the low-tension direct-current system or the operation could be reversed, as load conditions demanded. By the connection of the two direct-current machines in series to the local railway lines the sixty-cycle system could even feed the traction system or the reverse. The other motor-generator set consisted of a sixty-cycle 300-kilowatt synchronous

motor driving a rotary converter used principally as a double-current generator and supplying either 550-volt direct current to the local railways, or twenty-five cycle three-phase current for stepping up to 13,200 volts for transmission to the interurban substations. These two sets proved of inestimable value during the enlargement and rebuilding of the plant as they enabled machines to be cut out and changed about and at the same time permitted those machines that remained in operation to carry their full load for the supply of all five classes of service without appreciable interruption.

The activity of the new management in securing new business enabled it to foresee a period of great expansion for which the capacity, even with the additions already made, was woefully inadequate. Most of the old equipment of the plant also, while still giving good service, was reaching the period of obsolescence. The multiplicity of dynamos and belts, together with the line shafts, took up much room for a small capacity and required a relatively large number of station attendants. The retirement of this equipment to make room for the much more powerful and compact machinery of the present was evidently urgently needed. The necessary changes and additions were so radical and the task of making them without serious interruptions to the steadily increasing service was acknowledged to be so difficult that the alternative of building an entirely new station and later abandoning the old plant was considered. The excellent location of the plant, with its water power, abundance of condensing water, and good coaling facilities from two railroads, secured the adoption of the original plan, however. It was felt that the two auxiliary stations would afford some relief and that by proceeding cautiously the entire rebuilding of the station could be carried out with a minimum of expense.

Plans were therefore prepared for the new station to be thoroughly modern in all details and to anticipate a few years' increase of load. By ex-

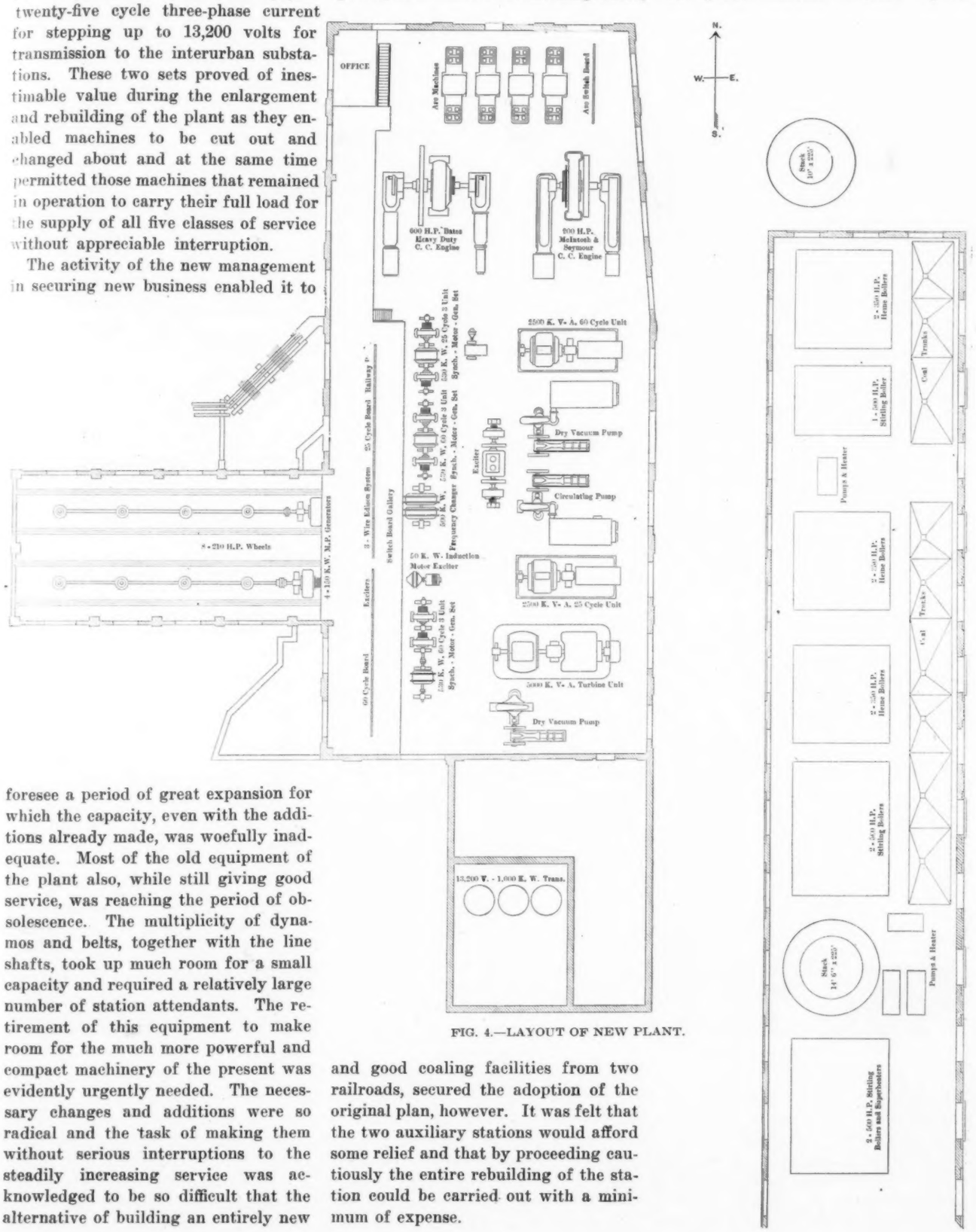


FIG. 4.—LAYOUT OF NEW PLANT.

tension to the south, future expansion may readily be provided for. Involved in the plans was the complete rebuilding of the water-power equipment, as well as the re-arrangement and extension of the steam-power apparatus. The layout of the new station, as it will be completed in a few months, is shown in Fig. 4. A comparison of Figs. 3 and 4 gives a fair idea of the most important changes and new work undertaken.

FIG. 5.—THE NEW ROOF OVER THE OLD ONE.

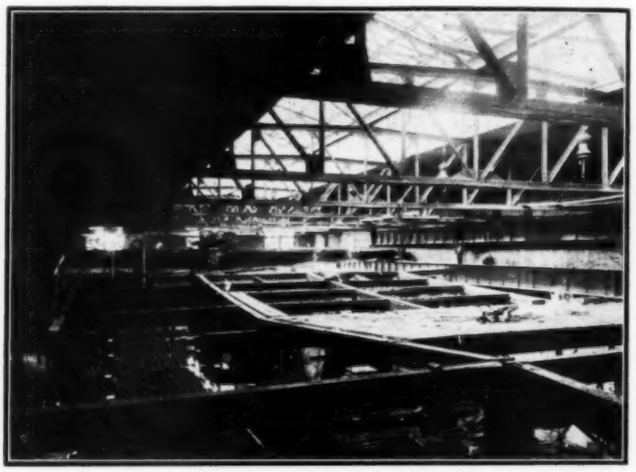


FIG. 6.—REMOVING OLD ROOF.

One of the first features of the reconstruction work to be taken up was the hydroelectric end. Although this part of the plant has now become the minor one, as its capacity is but 600 kilowatts, the water right makes a valuable auxiliary to the plant. The mean available head varies from nine to seven feet. The wheel house was completely rebuilt of solid concrete in 1909 and there was installed one new sixty-two-inch water wheel, making a total of eight wheels bevel-geared to two line shafts. Direct-connected to these shafts are four direct-current generators each developing 150 kilowatts at 125 to 175 volts. These partly supply the three-wire direct-current distribution system in the center of the city; this has been gradually restricted to the area of the densest load.

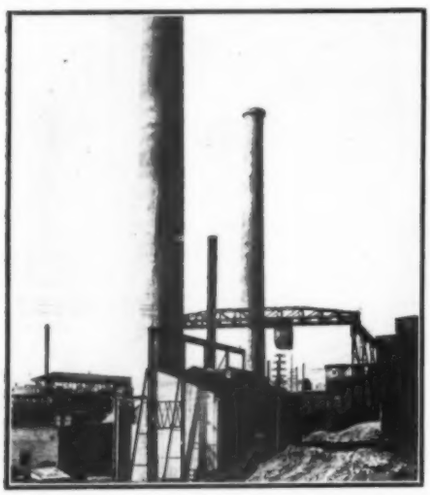


FIG. 7.—VIEW OF PARTLY COMPLETED PLANT FROM SOUTHWEST.

The Rockford Water Power Company, in which the Rockford Electric Company is heavily interested, built a new reinforced-concrete dam across the Rock River directly in front of the old wood crib dam. The new structure has a total length of 565 feet, an average height of twelve feet and an average width at the base of sixteen feet. The work on the new dam was completed in the record time of four and one-half months between July and December, 1910. Both day and night shifts were employed and an assortment of electrically driven machines was made use of. The Rockford Electric Company supplied current to three electric pumps, two derrick hoists, a concrete mixer and an air compressor, as well as a large number of arc lamps, all of which materially facilitated the work.

While the work on the river was proceeding, the rebuilding of the steam plant was also carried on without interruption. One of the first things done in this section of the plant was to extend the north end of the engine room and rebuild or strengthen parts of the other brick walls so as to provide a runway for an electric traveling crane and to carry a new trussed and reinforced-concrete roof. The walls were all carried higher and the new roof built over the old wooden one, as shown in Figs. 5 and 6.

Aside from the two 550-volt direct-current railway generators, each connected to a cross-compound engine, every piece of machinery in the engine room had to be either bodily thrown out or had to be shifted about to a more suitable location. The work had to be done piecemeal and required the greatest ingenuity in order to prevent serious accidents or breakdowns of service. The full details of how these changes were made would fill several pages of this article and can therefore only be summarized. A comparison of Figs. 3 and 4 tells the story effectively.

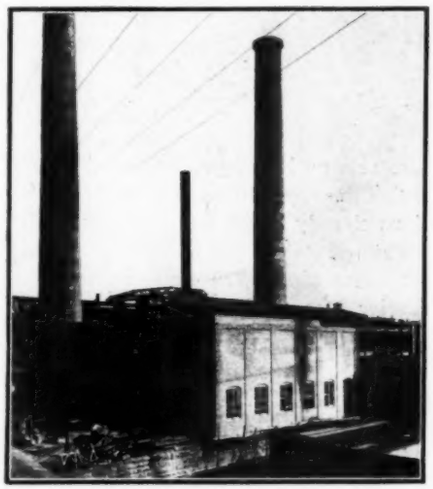


FIG. 8.—VIEW OF PARTLY COMPLETED PLANT FROM NORTHWEST.

The main generating units in the new engine-room equipment are three horizontal Curtis turbo-generators.

One of these is a 2,500-kilowatt, twenty-five-cycle, three-phase, three-wire generator for the interurban service; another is a 2,500-kilowatt, sixty-cycle, three-phase, four-wire generator for commercial lighting and power service; the third is similar to the preceding, but is of 5,000-kilowatt rating. The last unit is now being put in; the two others have been running for some time. All these machines generate at 4,000 volts, which is used directly for the seven sixty-cycle distributing circuits going to all parts of the city except the relatively small direct-current area; the current from the twenty-five-cycle machine is stepped up by three 1,000-kilowatt water- and oil-cooled transformers to 13,200 volts for transmission to the interurban railway substations. There are three of these high-tension lines, one going to Belvidere, another to Freeport, and the third to Beloit and Janesville.

To permit of ready interchange of load between the sixty-cycle and the twenty-five-cycle systems there is a 750-kilowatt frequency-changer consisting of two synchronous machines, each of which can be operated as the generator or motor.

Three motor-generator sets for developing direct current for the Edison three-wire system or the railway system are being provided. Each of these consists of a 750-kilowatt, sixty-cycle synchronous motor direct-connected to two 275-volt direct-current generators, one on each end of the motor shaft. By connecting in series the two dynamos of each set, the 550-volt railway load can be supplied from these machines.

The Brush arc machines of the old plant were found to be excellently suited for use in the street-lighting circuits. They were therefore moved to the north end of the engine room and coupled up in pairs to four motors of 200-horsepower each, three of these motors being direct-current to utilize the water power after midnight and the fourth alternating-current. The arc machines supply 6-6-ampere constant current to 125 arcs each. These four motor-generator sets therefore have a total capacity of 1,000 lights.

For excitation there was installed a 150-horsepower Westinghouse engine direct connected to two exciters, one for the sixty-cycle and the other for the twenty-five-cycle generators, and synchronous motors. These are 125-volt machines. There is also a seventy-five-kilowatt motor-generator exciting set, besides provision for exciting from the three-wire direct-current system.

In the old plant, the switchboard equipment was scattered around in different parts of the engine room, there being separate boards for the different classes of service. An entirely new equipment is being installed along the

FIG. 9.—GENERAL VIEW IN ENGINE ROOM DURING LATTER PART OF RECONSTRUCTION PERIOD.

west wall of the engine room, as shown in Fig. 4. Here a switchboard gallery is being erected with oil-switch and high-tension compartments underneath on the main floor. This gallery commands a view of all the generating and converting machinery and from it all this electrical equipment and the outgoing transmission and feeder lines are controlled, with the exception of the arc circuits for street lighting, for which a separate board is provided directly east of the arc machines. The entire switchboard is being equipped with the most modern indicating and recording instruments, remote-control switch-gear for the alternating-current circuits, regulating and protective devices, etc.

Before leaving the engine room it is necessary to refer to the condensing equipment for the steam prime movers. Each of the steam turbines has a separate surface condenser of Alberger make. The condenser auxiliaries are simplified by the fact that cooling water is taken from above the dam and discharged from the condensers below the dam, thus practically securing a syphon and requiring little power for the circulating pumps. The vacuum and circulating pumps are operated by a single engine for each condenser. Each of the turbines is arranged to exhaust into its condenser, into the district-heating system, or into the atmosphere. The two cross-compound engines for the railway service are each provided with a Bulkley barometric condenser. The exhaust from all the auxiliaries is used for feed-water heating.

The rebuilding and enlargement of the boiler room was carried on at the same time as the reconstruction of the engine room. The walls were strengthened so as to support a new steel truss and reinforced-concrete roof. An addition was built to the south and this arranged so it can be further extended as additional boilers are required.

The boiler equipment had consisted of nine water-tube boilers provided with under-feed stokers. The three oldest of these boilers were replaced one by one by Stirling boilers, each of 500 horsepower and equipped with a superheater. Two additional Stirling boilers were installed. The six remaining Heine boilers were completely overhauled; each of these is now also rated at 500 horsepower. Each of the eleven boilers was equipped with a Babcock & Wilson chain-gate mechanical stoker temporarily driven by stoker engines; motor drive will soon be installed for all stokers.

In the original plant, there was a great deal of manual handling of the coal both in unloading and firing. This has been entirely dispensed with. As shown in Fig. 7, there has been installed a Jeffrey bridge crane of seventy-foot span, which has a bucket capable of taking up fifty-four cubic feet of coal at one grab and can easily handle sixty tons per hour. This bucket is operated by two fifty-two horsepower motors for hoisting. Separate motors shift the bucket along the bridge and move the bridge along the track. The coal is picked up from the cars on the tracks spanned by the crane and dumped through an opening in the roof into coal trunks or hoppers of 500-tons capacity over the east end of the boiler room. From these hoppers it feeds through spouts to the stokers. A motor-driven crusher runs on rails over the roof and through this the larger sizes of coal are dumped before dropping to the coal trunks; thus any size of coal available on the market can be converted to screenings, for which the grates are adapted. The same crane is used for loading ashes from a pit in the basement into the railroad cars.

Two reinforced-concrete stacks were built, each having a height of 225 feet; the internal diameter of the north stack is ten feet and of the south stack fourteen and one-half feet. Both stacks are lined throughout with radial fire-brick. They are designed for zero tension in a hundred-mile wind and are of substantially monolithic construction. Adjoining the stacks are two Webster feed-water heaters and four feed-water pumps.

Throughout both the engine and boiler rooms new steam and water piping has been installed. All the steam piping is provided with steel fittings and valves and welded flanges. Four new headers were run between the engine and boiler rooms. As these pass over the open trackway between the two buildings, extra magnesia covering was applied to these headers and they were further protected by an external sheathing of galvanized iron.

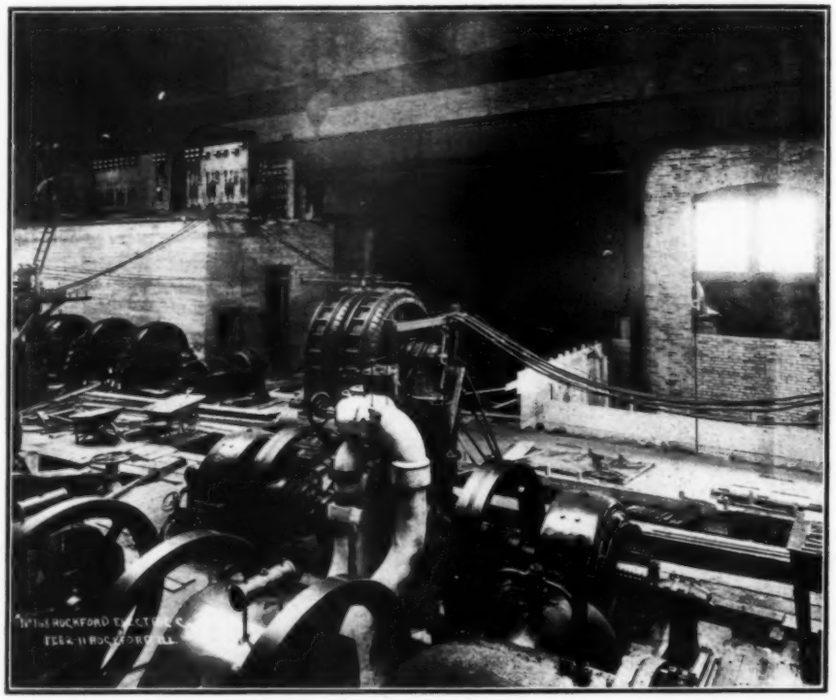


FIG. 10.—SOUTHWESTERN PART OF ENGINE ROOM WITH PART OF SWITCHBOARD GALLERY IN VIEW.

The foregoing has probably given some idea of the magnitude and character of the changes made in the Rockford plant in the last two years. Some conception of the difficulties encountered may be obtained from the accompanying construction views. In the winter of 1909-1910 a large part of the

outside wall surface consisted of tarred paper. Nearly all the time a large number of temporary cables had to be strung between machines and switchboards. But despite the generally torn-up condition of the plant during all these changes, it continued in active service without appreciable interruption and without serious accidents. In fact, the load was steadily increasing, which made the problem the more difficult, because before taking an old machine out of commission everything had to be in readiness to replace it by a new unit in the shortest possible time.

Before closing a review of the changes in the Rockford power plant, it is necessary to refer briefly to the striking growth of the Rockford Electric Company's system which necessitated rebuilding of its station. When the company took possession of the property in May, 1908, there were 1,369 consumers on the lines with a connected lighting load of 1,500 kilowatts and a connected motor load of 1,720 horsepower. In less than two years these figures had doubled. During the last two years this growth has steadily continued, so that now there are 3600 consumers, with a connected lighting load of about 6,500 kilowatts and a connected motor load of some 5,500 horsepower. Coincident with the rapid development of the residence and commercial lighting load and of the industrial power load, there has been an almost phenomenal development of electric vehicle load, there being in Rockford, principally through the efforts of the central-station company, now no less than 155 electric automobiles. There has been also a marked increase in electric heating and other electrical household applications, and in electric signs, of which there are about 180 with over 12,000 incandescent lamps. The railway load has steadily increased. While the street arc lighting has not been increased greatly, there has been developed a strong movement for ornamental street lighting with tungsten clusters on Minneapolis-type columns with four sixty-watt and one hundred-watt tungsten lamps in each cluster. With such a growth due to the adoption of the most progressive methods of new-business getting it is not surprising to learn that the average annual load factor on the central station has risen to over fifty-one per cent. The wisdom of the management in providing a modern station capable of still further enlargement is therefore apparent. For while the present rated prime mover capacity (11,650 kilowatts) provides the extraordinary generating capacity of one kilowatt for each four inhabitants, the time when even this will prove inadequate is not difficult to foresee.

The new dam was designed by D. W. Mead, of Madison, Wis., and the water-wheel house by M. B. Feldman, of New York. The engineering design of the steam plant was made by Sargent & Lundy, of Chicago. The entire reconstruction was under the supervision of F. H. Golding, manager of the Rockford Electric Company, to whom thanks are due for most of the data on which this article is based.

Anniversary Dinner to B. M. Downs.

H. M. Brookfield and F. Brookfield, of the Brookfield Glass Company, gave a dinner to B. M. Downs, vice-president of the company, celebrating the twenty-fifth anniversary of his association with that company, at the Union League Club, New York City, Friday evening of last week. The occasion was a particularly enjoyable one, and was attended by about twenty-five gentlemen, all acquaintances of long standing of the guest of honor.

Judge T. M. Debevoise acted as toastmaster, after an excellent menu had been discussed, and the first remarks of the evening were made by Frank Brookfield, secretary and treasurer of the Brookfield Glass Company, who expressed the appreciation that he and his brother, and also their father when he was alive, had for Mr. Downs, who, a quarter of a century ago, became connected with the Brookfield glass-insulator interests. Mr. Brookfield's remarks were received with much enthusiasm. Afterwards nearly every one in the pleasant company was called upon, and remarks appreciative and jocularly critical were made for the benefit of the guest of honor, the electrical gentlemen present developing into star orators in many instances.

At the conclusion of this symposium, Mr. Downs, the guest of honor, spoke at some length, referring feelingly to the pleasant associations with the company and its officers, and then, in turn, replied to the various speakers who had addressed their remarks to him during the evening. During the course of his remarks, Mr. Downs read a very complimentary and interesting telegram from Daniel C. Hemingray, of Covington, Ky., who expressed great regret at his inability to be present. Mr. Hemingray is the head of the Hemingray Glass Company.

Among those present were: Frank Brookfield, secretary and treasurer, Brookfield Glass Company; R. G. Hemingray, president, Hemingray Glass Company; R. E. Gallaher, secretary, New York Insulated Wire Company; W. L. Fort, Western Electric Company; R. B. Corey, president, R. B. Corey Company; E. W. Rockefellow, supply sales manager, Western Electric Company; J. B. Olsen, secretary, Habirshaw Wire Company; F. F. Downs, treasurer and manager, United States Can Company, Cincinnati; W. Joerger, General Chemical Company; W. S. Benedict, Benedict & Benedict; Herbert Sinclair, Star Porcelain Company; T. L. Cuyler, assistant treasurer, Postal Telegraph-Cable Company; C. C. Hay, Ingersoll-Rand Company; A. H. Pease, president, Hart & Hegeman Manufacturing Company; A. T. Clark, secretary, American Circular Loom Company; Walter Cary, manager, Westinghouse Lamp Company; B. M. Downs, vice-president, Brokfield Glass Company; T. M. Debevoise, George W. Elliott, Clarence Winter and Charles W. Price.

The menu was as follows:

MENU

Pamplemousses Glacées

Tortue Verte au Clair

Alose Désossée sur Planche
Concombres

Agneau de Printemps
Petits Pois Nouveaux Pommes Chateau

Sorbet Floride

Pintades Roties, Gelée de Groseilles
Coeurs de Laitues

Glaces aux Fraises
Petits Fours

Café

Perrier Jouet Brut
Apollinaris

The Mid-State Independent Telephone Association.

The Mid-State Independent Telephone Association was recently organized at Geneva, N. Y., by owners and representatives of twenty-four independent telephone companies. The association has for an object the advancement of independent telephone interests.

Missouri Electric, Gas, Street Railway and Water Works Association.

Fifth Annual Convention at St. Louis.

The fifth annual convention of the Missouri Electric, Gas, Street Railway and Water Works Association was held at the Jefferson Hotel, St. Louis, Mo., April 13, 14 and 15. The meeting was decidedly successful from every standpoint; there was present a large percentage of the membership of the association, and the well arranged and interesting program of papers, inspection trips and entertainment features left nothing to be desired.

The first session was called to order promptly at 10 a. m. on Monday morning. Pres. R. J. Irvine then introduced Mayor Kreismann, of St. Louis, who extended to the delegates a cordial greeting of welcome. He expressed the hope that the subjects considered by the association be of such nature as to benefit the public and officials, both state and municipal, as well as the utility companies, thus making for closer relationship between all concerned.

President Irvine replied very briefly, lamenting the fact that his recent illness prevented him from preparing a presidential address. The reading of the minutes of the last meeting was then taken up, this being followed by the election of new members.

In connection with the latter a discussion took place as to the advisability of admitting municipal plants to membership. In former years these plants were barred from the association. Supplementing a motion reversing this attitude, which was subsequently carried, Alten S. Miller, president of the Union Electric Light & Power Company, St. Louis, said that the barring of municipal plants was in direct opposition to fundamental objects of a state association—namely, those of co-operation and education. He said that such action would foster the impression that private plants were antagonistic towards the public and municipalities and that the association's aim should be to prove the opposite.

Minor business was then taken up, following which an adjournment was taken until the afternoon.

MONDAY AFTERNOON.

At the afternoon session a paper entitled "Centrifugal Pumps" was presented by W. H. Reeves. This paper, which was illustrated by curves and diagrams, is presented herewith in abstract:

CENTRIFUGAL PUMPS.

The early portion of this paper is devoted to a comprehensive review of the characteristics and development of the first centrifugal pumps. The conditions of design and manufacture which obtained up to the application of the electric motor to the centrifugal pump were described. Until that time development was confined to the single-stage pump but today greater efficiency and more satisfactory operation is inherent in practically all pumps of the centrifugal type. Explaining their characteristics of design Mr. Reeves said that while apparently they were very simple to the user, the manufacturer found many complex problems to solve. In connection with the subject of efficiency of pumps a government installation was cited where seventeen fifty-four-inch centrifugal pumps direct connected to constant-speed motors were installed, although their maximum efficiency was rated at seventy-eight per cent as compared with an efficiency of eighty-five per cent guaranteed by a rival bidder. This condition was due to the fact that greater horsepower motors were required to operate the higher-efficiency pumps. Mr. Reeves said that in considering the efficiency of a pump all of its characteristics should be considered and rigid tests should be made at exact contract conditions. The paper considers lubrication of pumps, and goes into a detailed discussion of the most suitable material for construction, typical designs of the various parts, etc. In conclusion, the method of operating centrifugal pumps as best suited to various conditions is taken up. For medium size plants the turbine-driven pump, which has some excellent features, was recommended for boiler-feed pumps. In steam stations operating non-condensing these units have become very popular. In steam plants operating condensing the motor-driven centrifugal pump was advocated.

The discussion was opened by H. B. Shaw, who asked if it was the custom of manufacturers to rate the capacity of pumps at their maximum efficiency. Mr. Reeves said that it was the practice and that the greatest efficiency ought to occur at the normal rating for which the pump is sold.

In reply to a question by H. H. Humphrey as to what development has been made in the use of multi-stage turbine-driven deep-well pumps, Mr. Reeves said that they have not been entirely successful. As a rule the wells are very small in diameter, which would limit the diameter of the impellers to a very few inches. Consequently the rotary speed would have to be very high. Exact alinement for these high speeds, also, could not be properly maintained on account of the long drive shafts which would be required.

Professor Shaw spoke of attempts to make the electric motor not constant speed, but variable, so as to give uniform pressure on different loads and different number of gallons per minute, and then to have an absolute limit. He spoke of some installations in buildings where elaborate electrical control systems are provided which virtually accomplished the stopping of the pump and having it always ready for operation.

In reply to a question asked by John Hunter as to the number of stages required for 200 to 250 pounds, Mr. Reeves said that boiler-feed pumps usually run about fifty pounds per stage so that a pump running at from 200 to 250 pounds would be a close decision between four and five stages, depending on the speed limitations of the turbine.

Professor Shaw asked if there was any accepted method of using one pump for an ordinary pressure of sixty pounds and a fire pressure of 120 pounds. He cited a case where one pump is driven from a line shaft and is so arranged that changing the speed of the shaft raises the pressure.

Mr. Reeves replied that the head varies as the square of the speed so that very slight variation will give quite a wide range in the head with the capacity remaining normal. This method limits the motors to variable-speed direct-current machines.

The next paper to be presented was entitled, "Lubrication." Owing to a mistake in the printing of the program, H. B. Shaw was given as the author instead of A. E. Flowers, of the University of Missouri. An abstract of Professor Flowers's paper is given herewith.

LUBRICATION.

The engineering experimental station of the University of Missouri has for some time been carrying on elaborate experiments relative to lubrication and Professor Flowers' paper was a preliminary report on this work, which when completed will be published in bulletin form. The author introduces the subject with an exhaustive commentary on the various classes of lubricants, the causes and effects of good and poor lubrication and the value of determining exactly what can be expected from the various methods of applying lubrication. It is absolutely essential to have surfaces well lubricated for the purpose of reducing wear, energy loss and temperature rise.

There are two different classes of service which are all important in a consideration of lubrication, namely bearings and steam cylinders. The characteristics of each of these two classes were fully explained by Professor Flowers. By means of charts which were exhibited the two forms of apparatus employed at the University were described. In both the apparatus for making tests on bearing lubrication and cylinder lubrication an electric motor is employed for driving the shaft and piston. In both cases the motor losses are subtracted from the motor input which gives the net input. From this the mean effective pressure required to drive the cylinder is obtained and the friction coefficient calculated. A test on a bearing 3.25 inches in diameter by nine inches long was conducted in which the shaft operated at a speed of 700 revolutions per minute with a total load of 176 pounds. Temperature readings taken at different runs averaged 35.6 degrees; current consumption averaged from 2.2 to 2.27 amperes; the motor loss averaged 0.57 amperes giving an average net imput of from 1.63 to 1.70 amperes. The friction coefficient corresponding to these readings averaged 0.02475. Three similar tests were carried on with the steam cylinder; one without steam in the cylinder, one with steam at atmospheric pressure and one with high-pressure steam. The general observation of these cylinder tests was that in cylinders, friction loss increases with increase in pressure in the steam. In conclusion Professor Flowers said that for every lubrication there is a set of working conditions under which the results found may be obtained.

In the discussion, P. E. Bertrand asked whether in making practical tests of lubricants, it is trustworthy to simply depend upon the temperature rise with the various lubricants—would it indicate the amount of power that is transformed from friction into heat.

Professor Flowers replied that the great difficulty is that you do not have constant room temperature to begin with. If you start with a certain room temperature and get a certain rise you will get a different rise if you start from a different room temperature. Absolutely constant room temperature is necessary for a test of that kind.

Alten S. Miller asked if any comparison of tests had been made between the apparatus described by Professor Flowers and the Thurston lubrication tester. Also whether the friction of the piston nearest the driving motor, which acts as a cross-head had been figured.

Professor Flowers briefly describes the Thurston apparatus, pointing out that it was excellent for testing bearing friction. He said with this apparatus a certain clearance for any good oil may be determined definitely but it does not determine a definite clearance for all oils. He recommended the Thurston apparatus particularly for railroad lubrication tests. In regard to the cross-head effect Professor Flowers said that he did figure it and his results show a difference of approximately six per cent.

Speaking of lubrication of cylinders when superheated steam is used, Mr. Miller said that the oil does not seem to adhere to the walls of the cylinder as it does with saturated steam and he asked if any tests had been made with different temperatures of superheat. Professor Flowers said that tests were now being prepared in this connection.

H. H. Humphrey briefly outlined an experiment he had carried out a number of years ago which comprised a test on bearing lubrication when an electric current was passing through the bearing.

P. A. Bertrand asked why certain materials are considered especially good for bearings and others are not, if it is true, as stated, that the surface of the bearing does not affect the friction if there is a sufficient film of oil between the moving and stationary parts. Professor Flowers said that in starting before the oil has spread wholly over the surface the metal surfaces are actually in contact and a certain amount of wear takes place; therefore good material is essential under those conditions of lubricating.

C. L. Clary said that he concludes from the experiments made by Professor Flowers that the splash system of lubrication is the most preferable.

Following this discussion, Judge Daniel D. Taylor, of St. Louis, delivered an extemporaneous address on the subject of "Liability Insurance for Public Service Corporations." Judge Taylor spoke of the high cost of insurance and outlined a plan that has already been started whereby an inter-insurance association, composed of St. Louis men will greatly reduce the prevailing cost of all subscribers to the plan. Each subscriber authorizes an agent to exchange indemnity on its behalf with other subscribers and the liability of each is kept individual. The plan contemplates that the insurance shall go only from one subscriber to another and any profits that are made belong to the subscribers. The exchange, or agents, will be under the control of an advisory board. Judge Taylor likened this plan to mutual insurance except that there is no common fund against liability risks but the liability of each subscriber is limited by the amount of his deposit. Judge Taylor said that the plan is new for public utility companies, but has been used for many years by laundrymen, lumbermen and others with excellent results.

FRIDAY MORNING SESSION.

The first paper at the session on Friday morning was entitled, "Illuminating Engineering," and was presented by J. H. McGlensey, illuminating engineer of the Union Electric Company of St. Louis.

ILLUMINATING ENGINEERING.

This paper was particularly comprehensive in scope, comprising a discussion of the underlying principles of illuminating engineering from the central-station standpoint; definitions of all terms encountered and suggestions and recommendations for typical and unusual installations with exhibits of practically all types of reflectors, curves of efficiency, and lantern slides of typical installations. Mr. McGlensey said that light is a quality; illumination the phenomenon produced by light and illuminating engineering the science of properly distributing illumination. He defined the terms: foot-candle, lumens, flux, law of inverse square and coefficient of reflection and in connection with the latter exhibited a chart giving the coefficient of reflection for practically every color and tint of interior decoration. Speaking of frosted versus clear-globe incandescent lamps, Mr. McGlensey urged the use of the full-frosted lamp in every case, equipped with proper reflectors. In connection with this a practical demonstration was made of all standard types of reflectors. Two lamps were hung in two darkened cabinets and by applying the different reflectors the varying results could be observed. This demonstration was supplemented with lantern slides of curves showing the distributing qualities of each type. Recommendations were made for each reflector in its particular field. Mr. McGlensey spoke briefly of store and office lighting, recommending clusters of 100-watt tungsten lamps, with proper reflectors, suspended near the ceiling. Indirect lighting was considered and views shown of approved installations.

Messrs. Bertrand and Gleeson discussed this paper briefly. Mr. Bertrand emphasized the importance of the idea that central stations should sell light rather than current. He spoke of store-window lighting and said that in Jefferson City no customer is allowed to illuminate his window with a single light source for the reason that it was sure to cause shadow. Another point recommended by Mr. Bertrand was an odd number of lamps, particularly in a small store, so that the alternate lamps can be placed on separate switches. He also advocates the placing of lamps near the four corners of a room.

Mr. Gleeson urged that the curves showing the comparative distribution about a clear and frosted lamp be reproduced and distributed to lighting solicitors to aid in better illumination.

The next paper was entitled "The Electric Vehicle," and was presented

by Herman Spoehrer, of St. Louis. An abstract of this paper is given herewith.

THE ELECTRIC VEHICLE.

The author directed attention to the enormous field of motor-driven vehicles of all kinds, stating that the sales for the past year amounted to $250,000,000. Many are pleasure vehicles, but the field of the commercial vehicle is enormous and has grown to its status in only a few years of development. In 1907 there were in St. Louis only eighteen electric cars, not giving very satisfactory service, but today that city has between 400 and 500 electric vehicles giving the best of service to the users. Mr. Spoehrer stated that his company was the pioneer in the development of central-station automobile load, and that in carrying out its policy of growth, it maintained at present eleven garages caring for electric vehicles. The revenue of three of these charging stations amounted to an average of $5,000 each per annum. In the case of central stations building up a vehicle load too much care can not be exercised in properly selecting the vehicles for certain classes of work, both as to capacity and type. The importance of satisfying perfectly those first to use electric vehicles is paramount. Quoting from P. D. Wagoner on the subject of central-station profit the author remarked: "There is no energy-consuming device that approaches the potential possibility as a curative of not only the daily load factor, but the yearly load factor, possessed by the electric vehicle, particularly the commercial vehicle, which has a duty to perform six days a week and every week in the year." This remark was enforced by a short table showing how the income from a vehicle compared with the income from lamps, flatirons, etc.

Following this paper lantern slides of the various types of electric pleasure vehicles were shown. There was no discussion.

"Ornamental Street Lighting," by N. J. Cunningham, was the next paper presented.

ORNAMENTAL STREET LIGHTING.

This paper discusses very ably how a street, building and interior appearance of a store affects business and the value of ornamental street lighting in this connection. The increased sign, window and store-lighting business which invariably follows ornamental street-light installations was cited as one strong argument for central-station activity in this direction, in addition to the revenue from current for such installations. Also one installation of ornamental street lighting brings on others. Much depends on the manner in which this business is secured and Mr. Cunningham referred briefly to various methods which have been successfully employed. It is bad policy to have the public reason that a central station is advocating ornamental street light simply to increase its profits. It is therefore advisable to have civic associations, business clubs, real estate men or others handle the business, the central station acting only in an advisory capacity. The paper states that by recounting the advantages of ornamental installations, such as increased value of property, greater business, city advertising, etc., in an impartial manner the central station need not take the initiative, except in extreme cases. The paper is concluded with detailed information relative to the street lighting installation in Springfield. Cost data are given on the various types of posts; rates, cleaning inspection, etc., are briefly referred to.

H. B. Shaw opened the discussion, asking whether the series or multiple system has been employed in Springfield and how the lamps are controlled. Mr. Cunningham said that at present all lamps were in multiple but a change to the series system was contemplated on account of the greater durability of the series lamp. There is one switch for each block in Springfield. In reply to a question by Prof. Shaw as to the relative merits between the luminous arc and tungsten installations, Mr. Cunningham said the tungsten lamp was preferred in smaller towns on account of the greater ornamentation possible.

O. H. Caldwell said that the only large series installation he has heard of is in Gary, Ind. He spoke of the method adopted in Toledo, for connecting the ornamental installation to the city are circuit.

P. A. Bertrand spoke of the higher cost of series installations as compared with multiple, on account of more expensive sockets and lead-covered cable being more expensive on account of carrying a higher voltage. He also said that putting an ornamental system underground would be likely to start agitation in regard to putting the whole system underground.

J. G. Harsh asked whether the cost of renewals is greater when tungsten brackets are attached to trolley poles. Mr. Cunningham said that at first the breakage was greater but with the new tungsten lamps it has been greatly reduced.

C. L. Clary spoke of arranging the lamps in series multiple thus combining the advantages of series lamps at the same time having low-tension wires.

AFTERNOON SESSION.

At the afternoon session the paper by H. C. Kimbrough, entitled, "District Steam Heating," was presented first. An abstract of this paper is given herewith.

DISTRICT STEAM HEATING.

This paper opens with a discussion of the importance of a public utility and the relation it bears to the community. The author states that in furtherance of a utility company's policy to contribute to the public's welfare, steam heating should be included in the commodities supplied. An exhaustive discussion is given as to the advantages of district steam heating, both to the consumer and to the central station. A few of the more important ones mentioned are: reduction of fire risk, no trouble, more satisfactory service, heat always instantly available during heating season, increased value of property, all for the consumer; and, increased revenue, greater value to a community, prevention of invasion of isolated plants, no additional equipment, etc., to the central station. A number of noteworthy steam heating plants are described and the expenses and profits given. Complete cost was also given for various classes of installations and the possible returns on the investment calculated.

Professor Shaw opened the discussion. He calculated, from the figures presented, that without steam heating a particular plant obtained one kilowatt-hour from sixteen pounds of coal and after steam heating was inaugurated, from seven pounds.

H. H. Humphrey asked of the relative investment between the steam-heating part of an equipment and the original electric equipment. Mr. Kimbrough said that it depends principally on the location of the plant from the business—or the amount of mains necessary.

Professor Shaw asked if comparisons had been made between total first cost of equipment for heating with live and with exhaust steam. Mr. Kimbrough replied that no definite comparison has been made but that all preliminary estimates are made on live steam mains which are of sufficient size to accommodate exhaust steam.

In reply to a question of President Irvine as to what has been done in towns of from 6,000 to 12,000 population, Mr. Kimbrough said that the greater per cent of all steam-heating business has been in towns of less than 30,000.

Professor Shaw expressed the opinion that high-pressure steam could be distributed more economically than exhaust steam and then supplied to the customers through reducing valves.

The next paper, entitled "Coal and Water Gas," was presented by P. A. Bertrand. It discussed the relative merits of coal and water gas, describing the features of manufacturing each and a comparison of their advantages. The paper was discussed by Messrs. Miller, Evans, Barnard, Murray, Lowe, Pulk and McArthur.

SATURDAY SESSION.

The concluding session on Saturday morning was given over to an executive session at which admendments to the constitution were made and the officers for the ensuing year elected. It was also decided to hold the next annual convention at Joplin, Mo. The following are the officers declared elected: F. E. Murray, Louisiana, president; P. A. Bertrand, Jefferson City, first vice-president; J. G. Harsh, Joplin, second

vice-president; C. L. Clary, Sikeston, third vice-president, and N. J. Cunningham, Springfield, secretary-treasurer.

On Thursday evening the manufacturers and St. Louis League of Electrical Interests tendered to the delegates a banquet, the feature of which was the stereopticon lecture on illumination and street lighting by W. D'A. Ryan, of the General Electric Company. By means of over 250 views Mr. Ryan described the development of illumination from its inception to the present time. All types of illuminants were illustrated in chronological order and many interesting typical and unique lighting installations shown.

On Friday afternoon the delegates were taken through the plant of the Laclede Gas Light Company and had an opportunity to view the new retorts recently installed there. In the evening the Sons of Jove held a successful rejuvenation, a large class being initiated.

Saturday afternoon a trip was made to the Ashley Street station of the Union Electric Light & Power Company where lunch was served and later the city water works and filtration plant was visited. A theater party on Saturday concluded the program.

Trains De Luxe for Electric Railway.

The Illinois Traction System will shortly place in operation two-car trains composed of motor car and trailer which will equal in every respect the parlor-car trains on the steam railroads.

The motor car will be of the library-buffet type and the trailer of the observation-parlor-car type. Both cars will conform to the latest practice in car building. An extra fare will be charged on all of these trains. The cars are being built in the shops of the St. Louis Car Company, St. Louis, Mo.

Merger Bill Vetoed.

Governor Aldrich of Nebraska has vetoed the Minor bill, which authorized a merger between the Bell and Independent telephone companies of the state. The governor contended that such a bill would stop competition.

A bill has been introduced into the Pennsylvania senate providing that all water-power companies furnishing power for manufacturing or other purposes, should also supply power to the public.

HYSTERESIS LOSSES IN SHEET STEEL.

MONTHLY MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The two-hundred-and-sixty-first meeting of the American Institute of Electrical Engineers was held at the Engineering Societies Building, New York City, Friday evening, April 14, with President D. C. Jackson in the chair. Attention was called to the meeting of the International Electrotechnical Commission which will be held in Turin, Italy, simultaneously with the Electrical Congress. It was requested that all members and associates of the Institute who contemplate attending this Congress should communicate with the secretary of the Institute.

The first paper of the evening was entitled "Effect of Temperature upon Hysteresis Losses in Sheet Steel," by Malcolm MacLaren.

EFFECT OF TEMPERATURE UPON HYSTERESIS.

Hysteresis measurements were made at temperatures between twenty-four centigrade and the transformation point (about 780 degrees) by a wattmeter method, readings being taken at both twenty-five and sixty cycles in order to eliminate the eddy-current loss. The range of flux density used was 6,000 to 14,000 gausses. Samples were in the form of rings 2.54 centimeters wide with a mean diameter of 27.0 centimeters. The thickness was about 0.04 centimeter. Commercial armature steel and high-silicon transformer steel were used. The heating was done in an electric furnace, the temperature being measured with thermo-couples. The wave form of the alternator used was approximately sinusoidal and precautions were taken to avoid distortion. The hysteresis loss with both materials decreased slowly at first with increasing temperature, but the rate of change increased more rapidly at higher temperatures. It became zero at about 780 degrees. The exponent representing the variation of hysteresis with flux density was found to vary between 1.56 and 1.61, the lower values usually applying to the higher temperatures. Throughout a large part of the range covered the values were close to 1.6. Check measurements were made by a ballistic-galvanometer method on the armature steel and the maximum discrepancy found was about seven per cent.

A paper was then read by L. T. Robinson, entitled "Commercial Testing of Sheet Iron for Hysteresis Loss."

COMMERCIAL HYSTERESIS TESTING.

This paper is a description of the methods carried out in the testing laboratory of the General Electric Company at Schenectady. These methods are discussed in the light of the practical requirements of makers and users of sheets under shop conditions. The requirements are: (1) the accuracy should be as great as that due to sampling the material; (2) dimensions, weight and treatment of sample should be such that the results represents the true average; (3) samples should preferably be uniform with those used by others; (4) the methods should be quick and inexpensive; (5) the services of experts or special delicate instruments should not be required. These conditions cannot be completely met, but two desirable forms of apparatus are described. The first uses a one-pound sample made up of strips 10 by 0.5 inches. These are used in a straight solenoid forming an open magnetic circuit. The voltage is measured by a secondary coil around the center of the specimen and is adjusted until its value is such that the actual loss in the entire specimen is the same as it would be with the nominal flux density uniform throughout the material. The wattmeter method of measurement is used at a frequency of ten cycles. The eddy-current loss is determined once for all for a particular grade of iron by running at other frequencies and a constant correction for this is made to the total measured loss. In addition to the voltmeter coil, the solenoid carries a magnetizing winding and an additional secondary which is connected to the potential circuit of the wattmeter. A liquid tachometer is used to observe speed and this and the reading scales of the wattmeter and voltmeter are arranged to be convenient to a single observer. The proper voltage to be used is determined by weighing the sample in a special balance graduated to give the voltage directly.

The second method uses samples three by fifty centimeters, weighing ten kilograms, and the arrangement is a slight modification of the Epstein apparatus. Readings are taken at sixty cycles and a sine wave is used. Some results are also given of tests made upon rings by both the ballistic method and the wattmeter method, the two showing good agreement. All samples are annealed after cutting and before testing. If this were not done the disadvantage of the small samples would be very great. Tests are usually carried on at a flux density of 10,000 gausses. The first method is considered to give a result correct within five per cent for the actual hysteresis, and the second method would give a total loss correct to two per cent. The accuracy obtainable with either arrangement is believed to be within the limits of the ability of manufacturers to produce uniform sheets. The accuracy of sampling with a ten-kilogram sample is within four per cent and with the one-pound sample within ten per cent. The expense of testing with the Epstein method, including cost of material, is ten or twenty times that of the first method. The first method is suited to cases where a large number of tests at low cost are required. Where the tests are less numerous the Epstein apparatus is more satisfactory, and on account of its good features should be regarded as standard. While the method used at the Bureau of Standards is more accurate, it is not considered suited to shop use, but rather to accurate research work.

The discussion was opened by Clayton H. Sharp, who asked why iron wire had been used for the winding and suggested that it might influence the measured losses. He suggested that the agreement of Professor MacLaren's results with the ballistic and wattmeter methods was not sufficiently close. He then discussed some of the other methods and apparatus for magnetic testing and some of the difficulties which are met in this work. The long-period d'Arsonval galvanometer has greatly simplified ballistic work. He has not found either the Picou or the Koepsel apparatus very satisfactory. In prac-

tical work not only hysteresis loss but the eddy-current loss should be known so that the wattmeter method of measurement was the most satisfactory, and should be made at a definite temperature which should be controlled and stated, and a standard temperature should be adopted for expressing results. He called attention to the variation of loss with wave-form and that the form-factor should be determined in a secondary winding. The different pieces of the test materials should be carefully insulated. The exact method of building a magnetic circuit is not important, but good joints at the corners improve the power-factor. The selection of a sample seems to be the most difficult question in connection with magnetic testing. With small samples doubt enters as to their representative quality. Considerable trouble is experienced in the testing laboratory from the fact that different samples are sent in in different form and it would be very convenient if a standard size of specimen could be adopted.

E. F. Northrup considered that iron measurements should be made from the commercial viewpoint since they are principally of commercial interest and laboratory precision is of small importance. Since conductivity decreases with higher temperatures it should be expected that the eddy losses would decrease also, but the figures given by Professor MacLaren do not bear this out. Since both eddy losses and hysteresis decrease with increasing temperature, these might outweigh the decreased copper losses and make a higher efficiency attainable in transformers when run hot. Experiments on the recalescence point in steels have shown a decided difference in the point found with increasing and decreasing temperatures. It is surprising that the same difference is not shown in the magnetic measurements. He thought a ballistic method of measurement could be made more rapid, more accurate and require fewer observers by making it partly automatic, using recording instruments. Progress in iron measurements should follow the line of seeking greater rapidity and using automatic processes.

J. A. Capp described some of the experiences of the General Electric Company in using Mr. Robinson's first method during the last ten years. In purchasing steel it had been found best to give only chemical specifications based on the best magnetic results obtained from a wide variety of material, since the heat treatment has a very great influence upon the quality. The best heat treatment was found by a large number of experiments and in the regular process of annealing the regularity and sufficiency of the annealing treatment is determined by samples distributed throughout the heating pot. Magnetic tests are used to supplement the pyrometers in checking the temperatures in the annealing furnace. When samples from a particular part of the annealing oven show poor quality, the punchings in that part are sent back for re-annealing. When specific designs require especially good material it is selected from regular stock through the testing of such samples, since the usual specifications are based upon the maximum loss and much of the material lies considerably below this. The extensive use which is made of this method of testing is possible only by reason of the speed which may be obtained and the small quantity of material required. In the regular work of this company 600 samples per week are tested on the average. This involves 26,000 strips, and it is done by two men.

L. W. Chubb criticised the use of iron wire for windings in Professor MacLaren's work and thought they would introduce error. Since the exciting current is high when the permeability becomes low, there would probably be distortion of the wave form at the high temperatures and this would decrease the apparent hysteresis. This would be intensified by the increase of resistance on the windings. In the Westinghouse laboratory a modified Epstein method is used with strips 15.5 inches long and 1.19 inches wide. About fifteen pounds of material is used without annealing. Results are found to be in good agreement with measurements made by the regular Epstein method. Voltmeter and wattmeter connections are made directly to the magnetizing winding, the errors thereby introduced being negligible. The copper loss in the primary winding is partially compensated by the error due to leakage of flux at the corners. Regarding the agreement between ballistic and wattmeter tests he pointed out that the ballistic results have usually been found lower and should be lower than the wattmeter results, due to the fact that the eddy currents produce a skin effect with the magnetic flux. He considered Mr. Robinson's method of clamping the corners excellent.

R. B. Treat said that testing by means of the one-pound sample is economical only for sheet makers or users who require many tests per week. The ten-kilogram apparatus is the more economical for infrequent tests, because of the use of commercial instruments which are returnable to the makers for repairs and good results can be gotten by the average operator. The one-pound apparatus requires the maintenance in usable condition of infrequently used special instruments, a thing very annoying and expensive. The high cost of material in the ten-kilogram samples is a disadvantage, but is to be preferred to the special instruments of the one-pound apparatus. Users of steel find it necessary to check the quality of incoming material with the supplier's guarantee. These samples should be sheared but unannealed, unless there is an agreement with the supplier that he will accept annealed tests. Some so-called annealing is ruinous to the material. Users of steel require also to know the properties of the material when incorporated in the finished apparatus. For this information the samples may be either sheared or punched, but should receive an annealing identical to the usual manufacturing process. The effect of cutting is small in a sheared sample, but may be very large in a punched sample. Samples can be japanned or shellac-coated at a very small cost, so it is advisable to do this and thus minimize the effect of pins on the edges. Japanning increases the weight of the sample about 0.5 per cent, dependent upon the thickness of the coat. Annealing under some conditions increases the weight about 0.2 per cent. The cross-section of the sample should be calculated from the weight and the longest dimension, for it is very unreliable to micrometer individual sheets. Areas determined by weight, and that by linear dimensions, may differ by ten per cent.

W. J. Wooldridge called attention to the relation between permeability and temperature. For low flux densities the permeability increases until near the recalescence point, and then drops suddenly, whereas at high flux densities there is a gradual decrease from ordinary tempera-

tures up. It therefore seems doubtful as to whether there is any general relation between hysteresis loss and permeability. The values of hysteresis in silicon-steel found by Professor MacLaren do not seem to follow the law of the 1.6 power. Eddy-current loss does not follow the theoretical relation to specific resistance. In ordinary iron, under common conditions, the eddy loss is about one-third of the total. In silicon steel with four times the specific resistance, the eddy loss is only reduced to about twenty per cent.

Andrew Pinkerton, speaking for one of the steel makers, thought it would be desirable to have some definite standard to work to in test.

W. R. Whitney found it desirable in the research laboratory to use small samples. The Ewing hysteresis tester had not given satisfactory results, and a one-pound sample had been found most convenient.

C. J. Fechheimer said that the methods which had been described were applicable principally to transformers, but the constants found in this way could not be used in designing dynamos or motors where there are heavy pulsations of flux in the teeth and the distribution of flux is not uniform. The actual losses are found from two to five times as great as determined in such tests. Although silicon-steel has a lower eddy-current loss and a slightly lower hysteresis loss than common steel, it does not give any better results in the cores of generators and motors, as has been determined by actually building four machines of this kind. This result has not been accounted for. Contrary to usual ideas, total core losses are found proportional to a power of the flux density, varying from 1.9 to 2.2, and to the 1.25 power of the frequency. This, also, has not been accounted for.

C. A. Adams pointed out the discrepancy between Professor MacLaren's results of 1.6 for the exponent for hysteresis in silicon-steel and the value found by W. J. Wooldridge, and given in the paper read at the Schenectady convention (see ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for February 25, 1911). The latter's values went as high as 3.25.

W. S. Franklin called attention to the desirability of making a distinction between errors of measurement and errors due to variations in the material.

Malcolm MacLaren then replied to some of the points raised, stating that iron wire was used as a matter of convenience, since copper was unsuited to the high temperatures used. No. 16 wire was used. He pointed out that in machinery the eddy-currents would not follow the change of conductivity of the material owing to the variable resistance of the oxide between the plates and the circulation of currents from plate to plate.

L. T. Robinson then closed the discussion, pointing out that most observers had not found the hysteresis proportional to the 1.6 power of flux density. Eddy-current losses also do not follow the law usually assumed, but it is necessary to make some such assumptions in order to make any progress.

The Congress of Technology.

The Congress of Technology which met in Boston April 10 and 11 in celebration of the semi-centennial of the signing of the charter of the Massachusetts Institute of Technology was a pronounced success on the two main lines laid out by its projectors. The Congress opened on the afternoon of April 10 with an address by President Maclaurin of the Institute on "Some Factors in the Institute's Success." The greatest of these, he said, was the method of teaching due to William Barton Rogers, the founder of the Institute, and now phrased as "the learning by doing."

The second day of the Congress was given over to the presentation of papers on various aspects of applied science. These papers were grouped in six divisions so arranged that the large numbers of the outside public which attended all the sessions were able to hear papers on the topics in which they were especially interested.

The Congress came to its climax with the banquet in Symphony Hall on the evening of April 11, when the enthusiasm of the thousands of Institute alumni and their guests, who filled the floor of the hall, was a sort of summary of the impressions made by the two days' proceedings. The papers presented at the public session gave to the audiences an extraordinarily adequate idea of how completely applied science shapes and controls the living conditions of the present. And as all the papers were by alumni or members of the faculty of the Institute it was also made clear how large a part the Institute had played in creating the applied science of today.

These two ideas were expressed along with the third idea more immediately practical at the great banquet. It has been clear for some time that the future development of the Institute of Technology is hampered by the lack of adequate endowments and buildings. The feeling that the beginning of the next half century of the Institute ought soon to see a New Technology, carrying on the standards of the past with greater facilities was the dominant note in all the speeches at the banquet. The alumni are eager to do their full share toward making this New Technology a reality. Their earnestness was shown by President Maclaurin's announcement that alumni have already definitely pledged themselves to give a very large part of the sum necessary for buying a new site for the Institute, and that Edward N. Hagar, president of the Universal Portland Cement Company has promised as a gift all the cement needed for erecting the new buildings in reinforced concrete. Meanwhile, the choice of the site itself, Dr. Maclaurin said, had been narrowed to three, all of which are within a short distance of the present buildings.

International Telephone Traffic.

A daily newspaper published at Gothenburg, Sweden, calls attention to the increased telephone traffic between southern Sweden and northern Germany, and states that arrangements are being made by the German administrations to improve and extend the facilities for such traffic. The service to Germany has been available for about two years. From Gothenburg one can talk to points as far south as Berlin, with results that are usually good, although the weather sometimes interferes. From Christianstad and Helsingborg connection is available as far as Frankfort-on-the-Main and Leipzig. The lines used for this traffic are equipped with special apparatus, making it possible to talk into the ordinary instruments installed in all offices. The rates for three-minute conversations from Gothenburg are: to Hamburg, sixty-seven cents; to Bremen or Berlin, eighty cents. The provision of these facilities for the ready transaction of business constitutes an added advantage for the German exporter doing business in Sweden.

CHICAGO BECOMES GREAT INTERSTATE TELEPHONE CENTER.

EXECUTIVE DEPARTMENTS OF FIVE GREAT TELEPHONE COMPANIES CONCENTRATE IN WESTERN CITY.

In conformity with the policy of the leading telephone interests of the country, an important consolidation of effort is being brought about through the placing under practically one executive head the five separate operating companies serving the western central states. The group of properties includes the Michigan State Telephone Company, comprising the state of Michigan; the Cleveland Telephone Company, operating in the city of Cleveland and nearby counties in Ohio; the Central Union Telephone Company, operating in the remainder of Ohio, all of Indiana, and Illinois except Chicago, and several nearby counties; the Chicago Telephone Company, operating in the city of Chicago and adjacent counties; and the Wisconsin Telephone Company, operating in the state of Wisconsin. Heretofore each of these companies has had a different president and a separate corps of general officers. The new plan contemplates one president and one corps of officers for the five companies, with specialists in the several branches of the whole work. There will be no change in the corporate existence of any of the companies, nor will there be any consolidation or merger of the physical properties. The new operating unit is being established to enable the management to keep pace with the growth of the business and to insure uniform efficiency of the service everywhere.

Bernard F. Sunny, now president of the Chicago Telephone Company, will be president of the five companies.

Alonzo Burt, now president of the Wisconsin Telephone Company, will be vice-president and treasurer of the five companies.

The general counsel will be L. G. Richardson, now president of the Central Union Telephone Company.

The general manager in charge of plant and traffic will be Horace F. Hill, now vice-president and general manager of the Central Union Telephone Company.

The general manager in charge of the commercial development will be Bernard W. Trafford, now vice-president and general manager of the Michigan State Telephone Company.

The general auditor will be Benjamin S. Garvey, now auditor of the Chicago Telephone Company.

J. G. Wray, now chief engineer of the Chicago Telephone Company, will be chief engineer of the five companies.

Angus S. Hibbard, vice-president and general manager of the Chicago Telephone Company, will take an important position in the eastern department. Mr. Hibbard's great service in developing the Chicago Telephone Company has been closely followed by Mr. Vail for some time, and the latter has insisted upon taking Mr. Hibbard from Chicago so that his great talent might be exercised in the east in co-ordinating the departments of the telephone and telegraph.

The new organization will nominally go into effect on May 1. The territory embraced in the new operating unit, it is estimated, has about 1,250,000 telephones, with a combined investment in the five companies aproximating $100,000,000. The gross annual business amounts to about $25,000,000.

Water Powers of the Cascade Range.

No area in the United States, it is believed by engineers, presents more favorable opportunities for the development of water power than that traversed by the Cascade Range, a large proportion of which is still owned by the Federal Government. The general elevation of the summit of this great plateau is from 6,000 to 8,000 feet, and many of its lofty peaks extend into the region of eternal snow.

The streams draining the Cascade Range have steep slopes and are fed during the low-water period by the many snowbanks and glaciers that mantle the high peaks or by the liberal supplies of ground water that exist in this region. The precipitation on the area is abundant, although its distribution is by no means uniform. The streams possess the features requisite for water-power development—rapid fall, abundant water, and comparative uniformity of flow—and the almost unlimited resources of timber, mines, and soil, as yet hardly touched, afford a promising market for these water powers and fix for them a high potential value.

The United States Geological Survey recently published, as Water-Supply Paper 253, a report on the water powers of the Cascade Range in Southern Washington, by John C. Stevens. This is the first of a proposed series to be issued, one each year, dealing with the water powers of the streams flowing from the Cascade Range in Washington and Oregon. The evident interest in the subject of the report resulted in the almost immediate exhaustion of the edition, and it has just been reprinted and can now be obtained by application to the Director of the Survey at Washington.

The streams considered in this report are Klickitat, White Salmon, Little White Salmon, Lewis, and Toutle Rivers, and other streams in the drainage basins of these rivers, all of which were surveyed under the direction of Mr. Stevens, by engineers employed by the United States Geological Survey and by the State of Washington, acting in co-operation.

These streams are all tributaries of the Columbia. The most important of them, considered as a source of power, is Klickitat River, which will furnish 154,000 horsepower at low water. The survey of the Klickitat covered seventy-three miles and included a total fall of 3,255 feet. The White Salmon, Lewis, Toutle and Little White Salmon take rank as sources of water power in the order named.

The entire system of streams surveyed will afford about 395,000 horsepower. The total water power available in the Columbia River basin has been estimated at 10,500,000 horsepower, so that the region covered by this first report will furnish only four per cent of the enormous aggregate, yet even this small percentage is five times the amount of water power already developed in the state of Washington.

The report contains descriptions of the rivers named and of their important tributaries, with tables showing discharge, the results of an extensive system of stream measurements, location of water-power sites, and the amount of power available at each site, annual mean and minimum discharge of representative streams of the northwest Pacific coast, and rainfall at numerous places in Washington and Oregon, also a summary of the water laws of Washington. A valuable portion of the report is a series of plans and profiles showing the course and gradient of each stream surveyed.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

POWER FROM PRODUCER GAS.[1]

BY GODFREY M. S. TAIT.

In order that a basis of calculation may be reached comparable to the widest range of power-plant sizes, we will consider plants of 1,000 horsepower output, and assume a nine-hour day, six days per week, fifty weeks per year, making a total annual period of operation of 2,700 hours.

It is recognized, of course, that in considering a 1,000-horsepower plant we are if anything favoring the steam-operated installation which is only abl to attain its maximum efficiency in plants of this size or larger, whereas, as will be noted in tables shown later in this paper, the gas-power installation has a practically fixed efficiency, regardless of the size of the installation, the one variable being the labor cost, which would assume a larger proportion of the operating expenses per horsepower as the size of the plant grew less.

Also in selecting a nine-hour day, we still further handicap the gas installation, as it has to write off its comparatively higher first cost in a much shorter number of working shifts per day.

However, it is the writer's wish to make the power comparison a fair one, and without any special load conditions to swing the argument in either direction.

In order to have a basis of comparison, first let us consider the average steam installation, of first-class design, and latest improved make.

The boiler plant in such an installation should be capable of delivering seventy-five per cent of the original heat value of the coal into the form of steam, and allowing a further loss of ten per cent between the boiler and engine, we have say sixty-five per cent of the heat value of the coal delivered to the engine. Assuming now (and it is a high assumption) that the engine efficiency is seventeen per cent in brake horsepower, this will give us a trifle better than eleven per cent efficiency for the entire plant expressed in terms of brake horsepower during time of operation, which is rendered still less efficient, when it is remembered that we have also to allow for standby losses at night, and over Sundays, amounting to a loss of about two per cent more. As against this let us consider the gas producer and its gas engine.

In the gas producer we find that the total heat value of the fuel is reduced but twenty per cent in its transformation into a cool washed gas, and as there is no condensation or other loss to figure on, we have eighty per cent of the original heat units contained in the fuel entering the engine.

We have taken No. 1 anthracite buckwheat coal as a basis of comparison in both cases, it being obvious that other sizes of fuel would have proportional costs. This fuel will be found to average 11,500 British thermal units per pound.

Any of the many standard makers of gas engines are willing to guarantee a brake horsepower from 10,000 British thermal units (some European makers guaranteeing 8,500 British thermal units); we, therefore, have eighty per cent of 11,500 divided by 10,000, which equals 0.982 of a brake horsepower-hour from each pound of fuel at full load, or a total efficiency for the whole plant of about twenty-five per cent as against the eleven per cent available from the steam plant before mentioned.

That the foregoing comparison is a most liberal one from the steam advocates' standpoint is readily shown when it is remembered that one year's test, of most complete accuracy, run on a steam plant of this high type of refinement, and under the very best of conditions showed but 10.3 per cent total efficiency, while on the other hand, the writer has installed gas-power plants where the total efficiency was over twenty-five per cent where twenty-four-hour-a-day operation allowed the elimination of the small stand-by or night loss.

In the face of such economies it would seem at first glance that the knell of all steam installations had been sounded, but the mere economy—great as it undoubtedly is—would not be, and is not, an attractive proposition unless combined with entire reliability, and ability to operate continuously twenty-four hours per day when desired.

Such service is, however, now obtainable but, due to the fact that unskilled and ignorant parties attracted by the apparent profits in the business have placed some utterly worthless forms of this device before the public, and worse still that the unsuspecting public has actually purchased this apparatus in many cases, it is not to be wondered at that in many quarters only bad reports can be found of gas machinery.

The situation today therefore as I see it is as follows: on the one hand, we have a device which generally in spite of its record for unreliability, is looked upon as a pronounced success from points of efficiency; but this device many conservative manufacturers will not consider on account of the many unsuccessful plants scattered around the country. On the other hand, we have a device which looks most simple to build, and which many manufacturers, totally unaware of the underlying chemical principle of operation, proceed to build and worse still to sell.

The natural result is that the gas-producer manufacturers who really understand the principles involved in the apparatus and who make a practical, economical, and reliable article (and the total number of such manufacturers of gas producers can be counted on one hand) are everywhere met with tales of the misdoings of these crude devices parading under the name

1 Abstract of a paper presented at the annual meeting of the National Association of Cotton Manufacturers, Boston, Mass, April 12-13, 1911.

of gas producers, and as a result the sale of such machinery in this country, with all its reputation of progressiveness, is ten years behind Germany for example.

In conclusion, I take pleasure in appending the actual records of some of the smallest gas plants, and ask comparison on your part with your knowledge as to what is possible under even the best of conditions with steam plants of the same capacity and load-factor.

Plant No. 1.

35-horsepower anthracite producer, 28-horsepower two-cylinder engine, 18-kilowatt electric generator (belted), Cost installed	$3,000.00
Interest and depreciation at 10 per cent	$300.00
Supplies and repairs	150.00
Labor per year	500.00
Total	$ 950.00
Fuel charge per kilowatt-hour with coal at $4.00	0.30 of a cent
Operating charges	0.61 of a cent
Total cost per kilowatt-hour	0.91 of a cent

Plant No. 2.

(24-hour-a-day service.)

150-horsepower lignite producer, 150-horsepower gas engine, 100-kilowatt electric generator, (direct current). Cost installed	$9,600.00
Interest and depreciation	$ 960.00
Supplies and repairs	480.00
Labor per year	1,700.00
Total	$3,140.00
Cost of fuel per kilowatt-hour	0.17 of a cent
Cost of operation per kilowatt-hour	0.43 of a cent
Total cost per kilowatt-hour	0.60 of a cent

Plant No. 3.

(24-hour-a-day service.)

300-horsepower anthracite producer, Two 150-horsepower gas engines, Two 100-kilowatt alternating-current generators, operating in parallel, Cost installed	$22,000.00
Interest and depreciation	$2,200.00
Supplies and repairs	1,100.00
Labor per year	2,400.00
Total	$ 5,700.00
Cost of fuel per kilowatt-hour	0.30 of a cent
Cost of operation per kilowatt-hour	0.40 of a cent
Total cost per kilowatt-hour	0.70 of a cent

Plant No. 4.

400-horsepower bituminous producer (suction type, 24-hour day), 400-horsepower tandem double-acting engine, 200-ton ammonia compressor (direct-connected). Cost installed (without compressor)	$ 4,400.00
Interest and depreciation	$4,400.00
Supplies and repairs	2,200.00
Labor (three shifts)	6,353.00
Fuel	2,916.00
Total	$15,869.00
Total cost 0.459 of a cent per horsepower-hour.	

This last plant was operating on Illinois slack of 10,300 British thermal units per pound, and containing four per cent sulphur and thirty-eight per cent volatile matter.

The above figures of actual operating plants should arouse interest, especially when it is remembered that the quality of water used is immaterial to the success of operation, a source of such frequent trouble in neighborhoods where hard or dirty water prevails.

There is one point which I wish to raise before closing. Don't try to buy bargains in the gas line. Those manufacturers who have solved the problem of gasifying American fuel have spent thousands of dollars doing so, and they therefore cannot afford to sell as cheap pound for pound, as the manufacturer who thinks he can copy a producer design and thus save experimental expenses. Purchasers of this class of goods have to conduct the experiments at their own expense, and to the great detriment of their own business, and find in the long run that they would have saved money, to say nothing of annoyance, by only dealing with parties who have actual plants in successful operation which can be visited and carefully inspected. Written testimonials are most misleading; a month after they have been written the plant may, under increased load conditions, have proven an utter failure.

However, do not let other people's mistakes prevent you from looking into this subject, but avoid the fatal error of calling for bids on the open market as if you were purchasing a stock article with which you are familiar. Rather put the matter in the hands of some engineer conversant with the state of the art, and hold him responsible in not only the selection of the plant, but its installation and operation for say the first year.

Auxiliary Steam Plant at Lagoon, Utah.

The Salt Lake & Ogden railway has had its fifty-five-mile interurban line supplied with power by the Telluride Power Company since it was electrified last year. An auxiliary steam plant has been built along the line between Lagoon and Farmington. It is of brick and steel with concrete foundations and reinforced concrete and steel trussed roof. The building covers an area 143 by 120 feet; the engine room is 53 by 120 feet and 49 feet high; the boiler room is 42 by 120 feet with a height of 59 feet; the high-tension bay is 54 by 24 feet.

The boiler equipment consists of seven boilers, one of 375 horsepower, two of 250 and four of 150 horsepower each. Coal is dumped from a siding direct into coal chutes open at the top. It is fed from these through hoppers to the mechanical stokers. Two steel stacks 65 feet high by 6 feet 6 inches diameter carry off the waste gases. Boiler-feed and condensing water is pumped from the nearby lake at Lagoon.

The generating equipment consists of two cross-compound Corliss engines connected to 380-kilowatt, three-phase, 2,300-volt generators and an exhaust-steam turbine developing 400 kilowatts. The turbine takes the exhaust from either engine and in turn exhausts into the condenser. It is contemplated to add another exhaust turbine in the future. In the engine room is located a substation for changing the generated current to 650-volt, direct current for the adjoining section of the line. The station is also tied in with the substations at St. Joseph, Clearfield and Ogden, the high-tension lines being operated at 45,000 volts.

Campaign Against Theft of Current.

Stirred to action by the unusual loss of current by theft, the Union Electric Light & Power Company, St. Louis, Mo., has taken drastic action to bring the offenders to justice, and the methods employed, aside from being of interest, may possibly offer suggestions for central stations similarly affected.

To secure a conviction in a current-theft case is particularly difficult because it must be proved that the defendant has knowingly diverted the current or tampered with the meter.

In a pool room in St. Louis a representative of the company unknown to the proprietor accompanied by a city detective entered the establishment and engaged in play. A uniformed employee of the company then entered and said that owing to trouble on the line he would have to read the meter. The meter reader on pretense of obtaining his instruments from the wagon, gave the proprietor an opportunity to remove the obstruction to the meter disk in the presence of the two witnesses. An arrest and conviction followed.

The same plan was followed in the case of a restaurant and a moving picture theater. The Union Company intends to publish these cases in the daily papers and thus curb the practice of current stealing.

The Construction of Standard Cells.

In the *Physical Review* for March there is an article by G. A. Hulett giving the details of construction of standard cells, the methods which have been found most satisfactory, the precautions to be observed, and the causes of the variations found in cells improperly constructed.

To do precise work with either Clark or Weston cells it is necessary to keep them at a constant temperature, and a thermostat is described which has proved very satisfactory.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

New York Section, Illuminating Engineering Society.

A meeting of the New York Section of the Illuminating Engineering Society was held in the Engineering Societies Building, New York, on the evening of April 13. In the absence of Chairman Elliott, Secretary A. J. Marshall presided. The program called for the presentation of three papers.

Two of the papers, "The Polar Curves of Finite, Line and Surface Light Sources," by Bassett Jones, Jr., and "The Photometry of Mercury-Vapor Lamps" by Joseph C. Pole were presented in abstract by the authors and discussed together.

FINITE LINE AND SURFACE LIGHT SOURCES.

Mr. Jones' paper is chiefly a mathematical study to derive expressions for calculating the polar component of the total flux from a light source so that theoretically correct polar curves could be plotted for comparison with those determined experimentally. The experiments had been conducted by him on sources consisting of plane areas of commercial glass arranged so as to emit a fairly uniform specific flux. A large number of polar curves had been obtained, so that a fairly accurate idea could be formed of the results that might be expected when any particular type of glassware was used in the construction of such sources for practical use. In the course of the experimental work it was found that certain forms of glass showed a polar distribution of flux density that closely followed the inverse-square law and cosine law when the source area was large enough to be practically useful and when the radius of the reading hemisphere was very little greater than half the source dimensions. Mr. Jones derives formulas for use in plotting the polar curves of a rectangular source and for a line source. The latter he also considers applicable to a cylindrical source, such as a vapor lamp.

PHOTOMETRY OF MERCURY-VAPOR LAMPS.

Dr. Pole's paper is a mathematical investigation of mercury-vapor tubes as sources of light. The customary photometers are based on use with point sources of light which obey the inverse-square law and the cosine law. The author uses these as bases for deriving an expression of the illumination generated by a straight line of light on a plane parallel thereto, also a formula for photometering such a source. In the second part of the paper he considers the luminous flux of a light-line for co-axial cylindrical surfaces and for concentric spheres; the total flux is found to be equal to the product of π^2, the length and the light intensity emitted radially by unit length of the uniform luminous tube. In part three is given the result of some experimental researches on mercury-vapor lamps. It was found that the light intensity is not uniform along the entire luminous column. It is constant and of the greatest intensity in the middle third and decreases near the electrodes. The ratio of the mean local light intensity of the entire luminous column to the light intensity of the middle third may, for practical purposes, be taken as 0.98. The light intensity and specific consumption obtainable was investigated for a number of direct-current mercury-vapor lamps; expressions are given for the normal current intensity and for the ideal efficiency. The lamps reach the best specific consumption at the normal current intensity. The smallest specific watt consumption theoretically obtainable decreases with increasing tube diameter. Similar investigations were made for alternating-current mercury-vapor lamps; these results indicate that the light intensity is the same as that of a direct-current lamp at the same average current intensity at the cathode, provided the two lamps have equal tube dimensions, equal current densities at the anode and the same heat-radiating conditions.

The discussion on these papers was opened by Dr. K. Norden, of Germany. He said that in arriving at the true lighting intensity of the mercury-vapor lamp—that means the light intensity measured at an indefinite distance from the source—he found in his measurements that, if the distance from the middle of the light-line is twenty-five times as much as the length of the light-line, it will be sufficient, and one will get the correct value.

Sidney W. Ashe stated that, as could be seen by Dr. Pole's paper, it is difficult to give a description which would be accurate for the total luminous efficiency of the mercury-vapor tube. In the past this has been done largely by a process of elimination. That is, if we were five times the length of the tube away, according to Dr. Hyde, such errors as might be introduced by considering the tube as a point source instead of a line source, would disappear. There is a happy medium to be chosen, to eliminate both sources of error, and therefore a distance of twenty feet is usually used.

Dr. A. S. McAllister said he wanted to confirm as well as criticise one or two points in Dr. Pole's paper. Attention should be called to the fact that the line source can be made up of several different kinds of sources. We can make up a line out of a cylinder if we can squeeze it down into a line source, or we can make a line from a series of points. If we apply the well known laws of the separate surface source, we get different values.

Bassett Jones, Jr., raised a question regarding the statement that the total flux of a light-line will not only be different for different species of inclosing surfaces, it will also vary within one family of surfaces from one surface to another. He might be wrong in interpreting this statement, but it looked pretty clear that the flux due to the line source will depend entirely on the character of the surface over which measurements are made; in other words, if you measure this flux through a sphere you get different results than if you measure it through a cylinder.

A paper on "Sign Lighting" was then read by O. P. Anderson.

SIGN LIGHTING.

Mr. Anderson opened his paper by dwelling on the remarkable growth of the electric sign business. Central stations have seen its possibilities and are actively pushing it. He called attention to the great advertising value of electric signs; they fill a new demand in a most unique way. Electric signs may be classed as either steady-burning or intermittent-burning. Each of these may be sub-classified in several ways. Thus there are reflector signs, panel signs, transparent signs, channeled signs, raised-letter signs, etc. Among intermittent signs are two principal types, the talking signs and flashed signs. The intermittent signs or combinations are the most striking and may be very attractive. In taking up the construction of signs, Mr. Anderson emphasized the need of good design and proper workmanship in the building of the sign and its erection. He gave a number of methods of wiring low-voltage tungsten sign lamps, which are now becoming very popular in five-watt, 11-volt size. On direct-current circuits these must be put ten in series or in series-multiple with ten sets of multiple lamps in series. On alternating-current circuits step-down transformers are invariably used. He also described a simple method of changing a sign wiring adapted for carbon lamps to a series or series-multiple wiring for low-voltage tungstens. Characteristic oscillograms and photometric curves of carbon and tungsten sign lamps were given. Outline and bill-board lighting were also referred to briefly as branches of display lighting akin to sign lighting. In conclusion, Mr. Anderson believed the sign business to be growing more rapidly than any other branch of the electrical business.

Joseph A. Becker opened the discussion by referring to the lighting of the Denver Gas & Electric Company's office building, which he considered very unique. He called attention to the fact that the blinds had been drawn in the upper part of the building to bring out the lighting effect. The fact was also discovered by the Butterick people in New York, the effect of their sign on the North River was impaired because of the lights in the windows of the building. Now, when the sign is lighted, all of the shades on that side of the building are drawn.

A. A. Wohlauer remarked that it was important to find the proper shape of trough to secure the best effect. One type of sign lighting which showed the results of study by illuminating engineers was the sign in the shape of a parabola, in the focus of which there is a lamp provided with a reflector. Outside of the desirability of the reflector, it is of importance to design the shape of the parabola in the proper way. He called attention to the unique method of sign lighting which consists in little cones, which are put on the letters, and these cones are illuminated by lamps placed around the edge of the reflector, and the cone on the reflector is divided in such a way that the rays of the lamps are reflected parallel to the eyes of the observer.

Mr. Becker stated that the growth of the sign business in New York City, in which he was particularly interested, had tended toward the low-voltage tungsten lamp. There had been some problems in connection with the life of the lamp and its durability and economy. He asked whether the coloring of the tungsten lamp, to secure an attractive effect, did not result in a shortening of the life of the lamp. It was his opinion that it did.

Mr. Anderson replied that it was a well known fact that the coloring of the lamp does cut down its life, due to the fact that when a lamp is colored more of its heat is retained.

A. L. Powell stated that the life of the lamp is to a certain extent proportioned to the absorption coefficient of the colored glass, and the same way with the frosted lamp. A blue lamp has a higher absorption coefficient than a red lamp, and the life will be about twenty-five per cent shorter with a blue or green lamp than with a red lamp.

ELECTRIC STREET LIGHTING.—IV.

BY ALBERT SCHEIBLE.

HORIZONTAL AND VERTICAL STREET LIGHTING.

Before taking up the more recent types of arc lamps—those in which the light comes chiefly from the luminescence of particles fed into the arc, rather than from the white-hot tip of a carbon electrode—it may be well to glance at an important change in the scope of street lighting from that which prevailed in the earlier days when the aim was largely that of lighting the surface of the ground, including streets, walks, yards, lawns and alleys. With the rapid growth of cities during the first quarter century of electric lighting and the improved methods of sanitation incident thereto, the back yards dropped out of consideration as parts of the city needing light after dusk. The alleys still needed attention, but as they are not used for traffic at night light for them is needed only for aiding the police in pursuing criminals and for preventing robberies. For this purpose sufficient light is easily provided by lamps at the alley entrances, sometimes supplemented by incandescents in the alley midway in each block.

But while the total area to be lighted in any given part of a city was thus reduced, the tests of satisfaction in the lighting of thoroughfares were gradually changing, for the reason that with the steady drift of population from the rural communities to the cities, the business aspects of the city streets were rapidly growing in importance. Rivalry between cities and even between different streets in the same city was tending to set new standards for street lighting, to warrant the use of a much higher intensity of illumination than was dreamed of early in the eighties when the lighting effect produced on a clear night by the moon in its second or third quarter was the implied ideal to be attained.

Wherever business men have been alert, this low intensity of illumination has been gradually raised, at least as far as the walks and roadways are concerned. Yet, strange as it may seem this increase of light on the horizontal street surface over that given by moonlight was not accompanied by anything like the fine distribution of light on the building fronts which characterize a bright moonlight night. The lower story of the building fronts might be clearly illuminated, only to contrast all the more sharply with the gloom of the unlighted upper stories, even on streets which were supposed to be well lighted. The effect thus obtained is just a little more spooky than the depressiveness which we sometimes meet even in the daytime on a foggy day when the mist prevents our seeing the upper portions of the buildings lining our streets, particularly of the high buildings in which every city takes a pride. The light on such a foggy day may be quite ample for guiding the paths of pedestrian and driver and for police duty as well, but unless it enables us clearly to see the buildings lining the streets, the effect is

FIG. 1.—TREMONT STREET, BOSTON.

depressing. Even more gloomy, if not actually uncanny, is the appearance at night of those business streets in our large cities in which the horizontalized street lighting is not reinforced by electric signs or store-front lamps which throw part of their light upwards against the buildings.

FIG. 2.—DAY VIEW OF PUBLIC SQUARE IN GOERLITZ, GERMANY.

Some of Chicago's business streets have long been notorious for such a morgue-like effect at night, but Chicago is by no means alone in this respect. In Fig. 1, for instance, is a part of Tremont Street in Boston, showing how even the use of a highly-modern type of lamp (6.6-ampere magnetite arc), while lighting the walks and roadway, still fails to bring out enough of the building fronts to give the street that cheerful and attractive appearance for which the more alert business men in all live cities have been striving during the last half-dozen years. The more ideal lighting would certainly aim to come nearer to the clear daylight and moonlight effects which never confine themselves to the lower twenty feet of the building fronts. Perhaps our American tendency towards using electric signs high up on buildings and sometimes of decorating the buildings with rows of incandescents, has given out the false impression that unaided street lights could not illuminate the building fronts in their entirety. Any such notion should have been upset some years ago by the success of prominent European cities in lighting both sides as well as the surface of their streets.

FIG. 3.—NIGHT VIEW IN SAME SQUARE ILLUMINATED BY FLAMING ARC LAMPS.

Germany in particular has learned how to rival the daylight after dark without enlisting the aid of store-front lamps, outline lamps or signs. For example, Fig. 2 shows a public square in Goerlitz, a street difficult to light adequately because of its wide expanse. Yet Fig. 3 shows that even without the assistance of any commercial lamps close to the buildings themselves, the fronts of these are lighted all the way up to the eaves, while the roadway shows an unusually good distribution and high intensity of light. No doubt the darkening of building fronts by the omission of bright signs (which are much more restricted by European regulations than they are here) was a factor in enabling the Europeans thus to outstrip us in their street-lighting effects. But even more so was the fact of their practically skipping two types of arc lamps which formed such important steps in the progress of American street lighting, viz., the inclosed arcs and the luminous (magnetite or metallic-flame) arc lamps. For, instead of taking up with these, the Europeans clung much longer to the old open-arc carbon lamps and then passed directly to the type of lamp which Americans until recently have ignored as a factor in their plans for street lighting—the impregnated carbon or so-called "flaming-arc" lamp.

(To be continued.)

Arc-lamp Switching Pulley.

A valuable adjunct to arc-lamp suspension appliances has been devised by Albert Scheible, of Chicago, and recently patented. It is a switching pulley in which a single dog alternately catches and releases the lamp hook, disconnecting the lamp from the circuit when it is lowered for trimming or inspection.

Convention of Nebraska Association.

The fourth annual convention of the Nebraska Electrical Association will be held at Lincoln on April 24, 25 and 26. Headquarters will be at the Lindell Hotel.

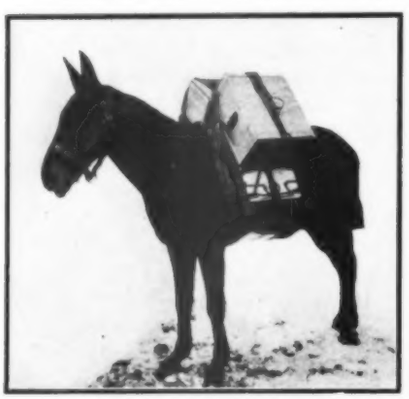
TELEPHONY—TELEGRAPHY, and WIRELESS.

THE DEVELOPMENT OF WIRELESS TELEGRAPHY IN THE SIGNAL CORPS OF THE UNITED STATES ARMY.

BY E. A. WOODWARD.

The extent and importance of wireless systems of signaling in the army are facts that are very little appreciated by the public at large.

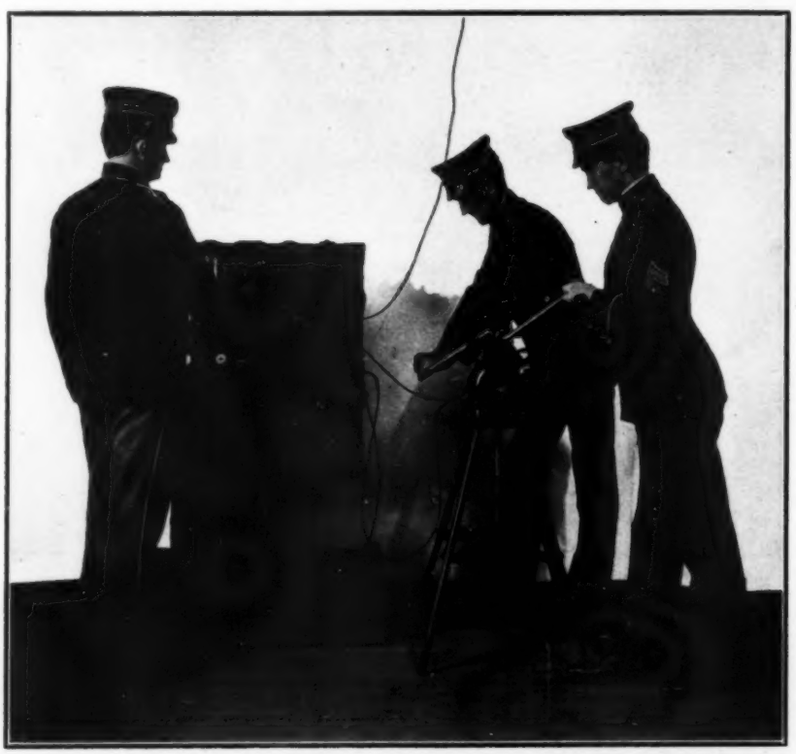
So far as a mobile command is concerned which is operating in an open country with no lines of communication available save their own, the field wireless equipment is the most important and consists of transmitting and receiving sets mounted in "pack chests" strapped to the back of an army mule or transported by a light four-wheeled wagon drawn by two horses.



FIELD WIRELESS PACK SET.

Pack chests are heavily bound with iron and can stand hard usage and knocks. When it is necessary to operate, the straps which bind it to the animal's back are loosened and it is set on the ground.

The transmitting set consists of a closed-case transformer, the primary of which is connected in circuit with an atomic type of interrupter, but the sets in use at the present time are operated at a comparatively low frequency, say sixty cycles and below. The condenser used consists of a battery of units of the glass tubular type, each about ten inches in length by one inch in diameter, filled with graphite inside and covered with foil; they are arranged in multiple, the tops and bottoms resting in clips and they may be detached instantly if desired. This condenser is mounted on the cover of the chest and near it on the right is the tuning helix for sending. It is a spiral mounted on the back of a hard rubber plate, the various adjustments being obtained by binding posts set into the face of the plate at regular intervals. The rest of the sending side needs no description, as key, spark gap and so forth are standard.



PACK SET IN OPERATION, WITH HAND-DRIVEN GENERATOR.

The receiving side is also standard, using the straight tuner and silicon detector with double head telephones. The aerial is of the umbrella type and is the most bulky part of the apparatus. It consists of sections, each eight feet in length and made of split wood, hollow and comparatively light and accomodating in each end a piece of Shelby tubing about two feet in length , half of which protrudes, so that a pole from 40 to 60 feet can be made by fitting one into another. This support is for the six phosphor-bronze stranded antenna wires constituting the aerial. It is easily seen that these wires also constitute the guys to support the pole in an upright position.

This completes the field equipment with the exception of the source of power which is either a storage battery or a small direct-current dynamo operated by hand. The latter is the source of power most depended upon in districts where charging circuits are too far away to be available for recharging.

The range of transmission varies with climatic conditions, of course, but

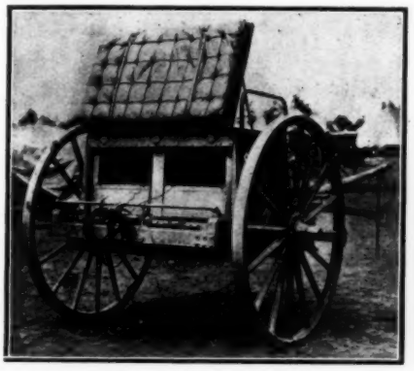
twenty-five miles may be said to be the limit usually attained.

Where a position is taken up, one set is put in operation in close proximity to the headquarters and the others are pushed out to the front and erected in strategic positions so that important movements can be directed by headquarters and any news of importance transmitted thither. The time required to set up the apparatus is about two minutes in actual practice, and it may be taken down as quickly. Records of much less time have been made by competing sections at the various tournaments. A wireless section of the Corps consists of a sergeant, two corporals and six men, though this may be varied according to the men that may or may not be available, or other circumstances. The most important factor to be considered is that the section be able to keep up with the troops with which it is operating and, if cavalry or artillery, it may mean anything from a slow walk to a dead run.

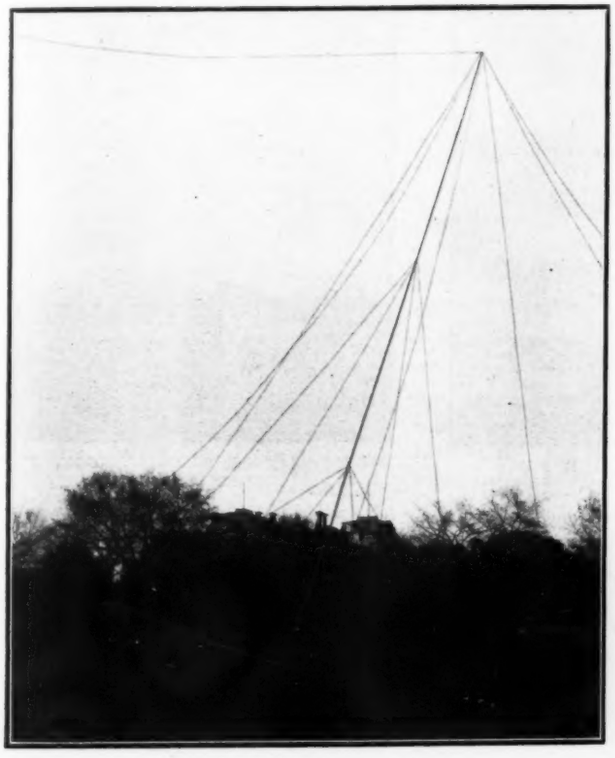
So far as the question of transportation is concerned it has been proved time and again that apparatus, to be fully practical, must be in such shape and of such weight that in case of horses being killed or captured the apparatus can be handled by one-man power, and it is the writer's impression that the transportation factor is by far the most important point for consideration in designing wireless sets for the use of a mobile force.

Having examined the apparatus in use and considering all its advantages and disadvantages, there seem but two practical methods of insuring the presence of the set where it is needed: First, that the set must be divided into small carrying cases slung over the shoulder by the men and available for use at any time by simply setting the cases in proximity. Horses and mules may be captured or killed, wagons may break or suffer capture and it seems almost certain that after a time men would have to be depended upon to carry the apparatus. Second, an auto-

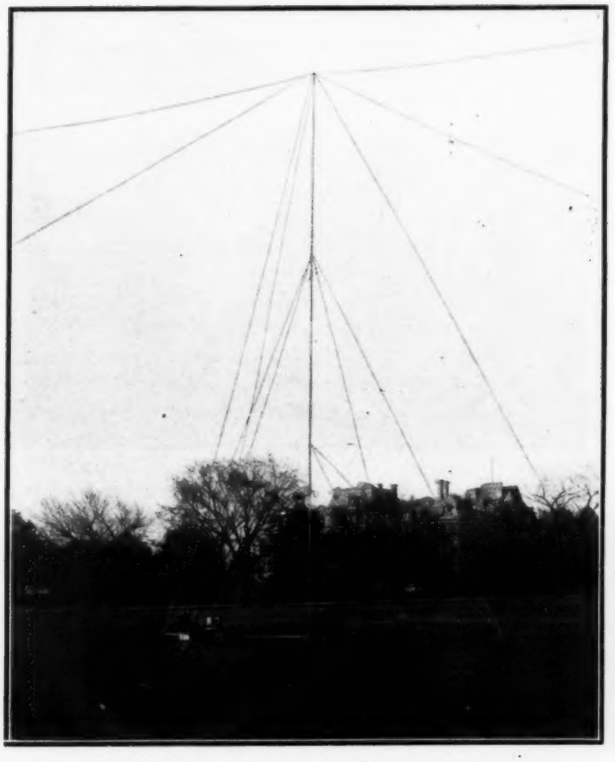
JOINTED MAST ON THE GROUND.



PINTLE-TYPE WIRE WAGON.



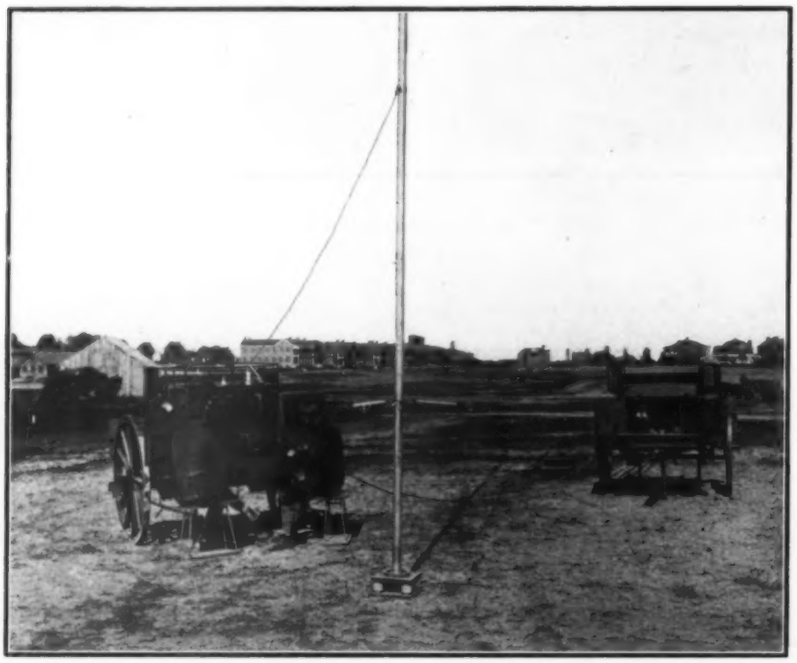
JOINTED MAST, PART WAY UP.



JOINTED MAST, IN POSITION FOR USE.

mobile constructed so that it will be able to stand the strain of an uneven country and the hard knocks of a campaign, and fitted with a suitable set of at least one-kilowatt capacity. This would enable the machine to transmit messages to a greater distance than present equipment affords. The source of power would be either a direct-current or alternating-current generator geared to the engine. This would do away with the hand-operated dynamos or storage batteries and the superior speed and ease of handling would render the machine much more practical.

The method of operating a wireless set in the field is as follows: When patrols are sent out for the purpose of reconnaissance a wireless set is sent out with them, generally being transported in a light field wagon drawn by two horses or four mules as the case may be. The outfit is set up at a point that is concealed from the enemy and orderlies with messages are sent to it from the advance positions of the patrol and as soon as the ground is reconnoitered in front, the set is assembled and brought up from time to time until the enemy is observed. If a reel cart is available it may work in conjunction with the patrols nearest the enemy. A reel cart is simply a large reel of insulated cable, composed of stranded copper and steel wire and very tenacious and strong as well as being a good conductor. About five or ten lines of this cable is wound on the drum and, owing to the high resistance of the insulation, telephonic and telegraphic communication may be kept up with the line lying on the ground, passing through streams and, in short, in almost any condition. I have known a land line laid over four miles, under water in two places, and passed under several roads by digging a trench and burying the cable, to give good service telephonically for some eight or ten hours and finally when it was discovered and cut, at a road, the two ends being in contact with the ground at that point, although telephone communication was out of the question, the high inductive factor of the buzzers enabled all messages to be transmitted by telegraphic code with perfect distinctiveness and accuracy.



TWO-KILOWATT TELEFUNKEN FIELD WIRELESS-TELEGRAPH SET.

The buzzer is an induction coil with the primary and high-frequency interrupter in series with a battery of dry cells, a telegraph key and a telephone transmitter of the microphone type.

The telegraph key is always in circuit and the transmitter may be cut in by a push button mounted on it when it is desired to converse verbally. The secondary in series with line, head telephone and ground develops an enormously high voltage and is marvelously efficient.

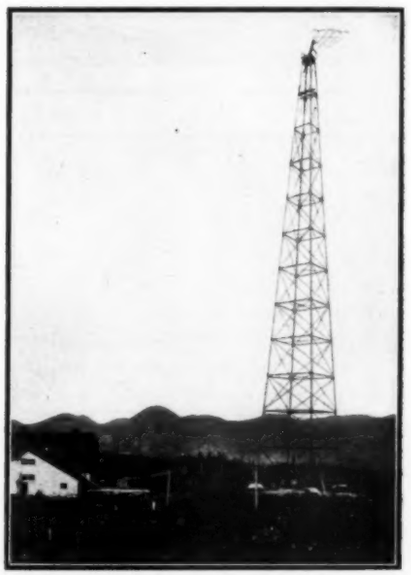
Wireless Set for British Army.

The British Army is making use of a portable set for wireless telegraphy, capable of being carried by four horses. It consists of a two-cylinder gasoline engine and an alternator, two masts, thirty feet high, each made in five lengths, transmitting and receiving apparatus, aerial, etc. It has a range of about twenty miles.

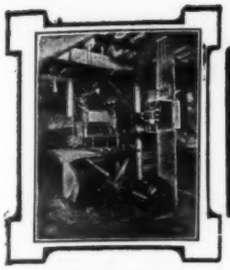
Telephones in a Cathedral.

What is believed by many to be the largest and most magnificent church edifice in this country has been under construction for many years at Morningside Heights in New York City. It is the Cathedral of St. John the Divine, which was dedicated on April 19.

The great size of this cathedral has required the installation of an extensive intercommunicating telephone system. There is a telephone at the highest point of the dome. There are telephones in various parts of the choir galleries. One of these by the station of the organist and choir master connects with the stalls in the choir, so any section of the choir can be communicated with. The telephone system extends to the Synod Hall, where the canons have their offices and where the choir school has sessions, also to the business offices in the basement of the hall, and to the work house on the grounds. When the great spire is built there will probably be a telephone at its top, which will be more than 400 feet above the sea level.



WIRELESS TELEGRAPH STATION, FORT EGBERT, ALASKA.



Industrial Power

ELECTRICITY IN THE MACHINE SHOP.[1]

BY C. W. JOHNSON.

In almost any machine shop it will be found profitable to drive many of the tools at varying speeds. It is not always convenient or possible to obtain the desired speed range by mechanical devices and retain the necessary quick operating features, so the adjustable-speed motor has been developed. In its present form this motor is the outcome of many years of development and is a shunt-wound, auxiliary-pole motor. Controllers can be designed to give any number of speeds forward or reverse, but it is customary to provide sixteen forward speeds and fewer reverse. On a four-to-one motor, sixteen speeds give an increase of speed to very nearly ten

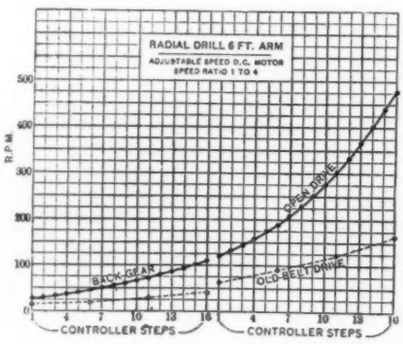


FIG. 1.

per cent for each notch on the controller.

In any system of speed adjustment the ideal is attained when the speed can be increased by constant percentage increments. This is known as geometric progression as distinguished from arithmetic progression, in which each increment is equal to the preceding one. It is generally conceded that ten per cent increments are satisfactory, and when these are increased to fifteen or twenty per cent production is restricted, and time and money are wasted because tools cannot be operated at the most efficient speeds. Any discussion of correct and efficient operating speeds presupposes an organization and system which will obtain the maximum output from operators. One of the greatest obstacles has been removed now that an operator can reach, without changing his position, a simple lever by which he can control the cut-

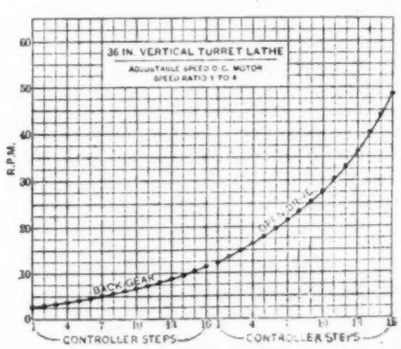


FIG. 2.

ting speed of his machine throughout a considerable range by increments of ten per cent.

Fig. 1 shows a graphic speed chart of a standard belt-driven radial drill, and of the same tool equipped with an adjustable-speed motor and one change in gearing. It will be noticed that only eight speeds are obtainable with the old belt drive, having one change of gears and a four-step cone pulley. This drill is one of probably twenty-five to thirty in one shop, all used on a varied class of work, comprising drilling, counterboring, and tapping various-sized holes. Several of these drills have been converted to motor drive with a marked increase in output. The increased output depends upon the class of work, as there would be no increase if the same sized holes were being drilled at all times, provided the proper speed could be obtained for that hole. In this case the work was constantly changing, and workmen rarely shifted the belt on the cone pulley and only changed the back gears. Nevertheless the shop was considered progressive, and used a modern system of wage payment which was supposed to secure maximum output from the men. Little time would probably be saved by shifting the belt to change the speed, as this is a slow process, and the workmen avoid it whenever possible.

With the motor drive and the back gears arranged to be changed quickly, the operator can readily be induced to work at the most advantageous speed. The men are enthusiastic about the change in drive, and willingly accept a cut of three hours on a ten-hour job, which a careful study of conditions shows to be a very moderate estimate of the saving. If we assume earnings of thirty cents per hour and an overhead charge of 100 per cent, a man will do work in one day on the altered tool for $3, or a factory cost of $6, which formerly cost forty per cent more, thus

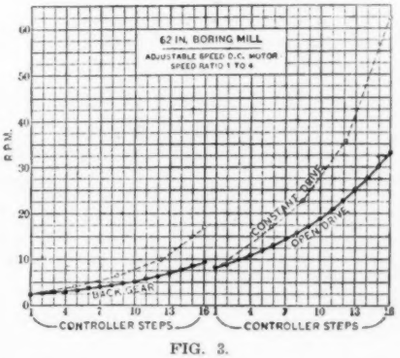


FIG. 3.

making a saving of $2.40 per day. This saving will pay for the tool in a short time, and does not have one wondering just what percentage of the investment must be saved per year to justify the expense. We have dwelt on this drill-press case for several reasons. The tool is universally used, and is not given the attention it deserves in many shops. Also the statements made regarding the advantages of applying motor drive to it apply to almost every tool where a variety of work is turned out.

Records of lathes, drill presses and boring mills, notes upon charts of the correct running speeds for all classes of work regularly done on each tool, and a

1 Abstract of paper presented at Metal Trades Superintendents' and Foremen's Club, Cleveland, O.

consideration of the time and manual labor required to make the changes in speed, would be a revelation to many and emphasize the desirability of adjustable-speed motors. Such records should be compiled and charted for all existing machine tools in the shop, unless they are specialized, and it is known that correct speeds are readily obtainable. It is equally advisable to secure the same information on tools about to be purchased, for it is often surprising to note the poor assortment of speeds which some tool manufacturers offer.

Fig. 2 shows speed curves of the most modern of tools, a thirty-six-inch vertical turret lathe, with mechanical speed changes. Fifteen speeds are obtainable in almost exact geometric progression with twenty per cent increments. Such results are exceptional, and the manufacturers deserve great credit, yet twenty per cent increments are rather large where the highest efficiency is desired. Also the friction in the gearing is of considerable importance and greater speed range, more speeds and smaller speed increments can be secured by leaving off the extra gearing and installing an adjustable-speed motor. This will mean but a very small addition to the first cost of the tool.

Fig. 3 shows a chart of a sixty-two-inch vertical boring mill. This mill has not been changed to motor drive, but the chart shows how desirable that would be. When belt-driven, the speeds overlap, so that in reality only eight speeds are obtainable, and of them at least one is higher than can be used. It is needless to point out what a saving a motor would be on this tool. The point I wish to impress, however, is that such tools are not the exceptions but the rule in the average shop.

A chart was also shown of a modern heavy-duty radial drill press. It is interesting in several respects. The motor is rated at 12.5 horsepower, at 400 to 1,600 revolutions per minute. Single speeds from thirty to 120 revolutions per minute are obtained with back gears in and 125 to 500 revolutions per minute with gears out—thirty-two speeds altogether. A competitive drill test was recently conducted on this machine. Grading the drills in three ways, according to the inches of both steel and iron, they would drill without distress, the same when run to destruction, and the horsepower required to drive each drill under all conditions as determined by a recording meter. Naturally the drills which required the least power gave the longest life. There was an appreciable difference in this power, and the readings with different drills of the same manufacturer were consistent.

In these tests the 12.5-horsepower motor was frequently run up to thirty-five horsepower. While it is not recommended that motors be run for long at such overloads, yet with the extremely intermittent work on such a tool, there is little danger of injuring the motor with overloads. In general, when motors have been put on machine tools they have been too liberal in size. Properly proportioning the motor to the work will greatly reduce the cost, and much work is now being done toward determining the proper size of motor for various classes of work.

In considering small group or individual motor drives in a machine shop, it is usual to lay great stress upon the power to be saved as compared with long lengths of line shafting. While power, and frequently a large amount of it, is thus saved, the feature of prime importance is the effect on production, and any scheme which will increase the output of a given equipment and floor space even a few per cent, will justify a considerable investment. —*Industrial Engineering.*

Telephone Rates in Europe.

Statistics recently collected by the British Government on European telephone lines show that the rate for unlimited service is $49 in Antwerp and Brussels, $78 in Paris, $58 in Lyons, $20 to $44 in Germany, according to size of exchange, $39 to $58 in Italy, $25 to $28 in St. Petersburg, $37 to $41 in Moscow, $83 in London, and $23 to $81 in Austria.

Measured service is also supplied in many places.

Chicago's Street Railways.

The city of Chicago received $6,109,845 from the street railways in the last four years, according to a recent report.

This sum represents fifty-five per cent of the net earnings of all the surface lines in the city, and is paid to the city in consideration of a twenty-year franchise granted four years ago.

A NEW TYPE OF ELECTRIC FURNACE.[1]

BY CARL HERING.

Let the circle, Fig. 1, represent the cross section of a cylindrical conductor; the forces known as the "pinch phenomenon" will then act radially as shown by the arrows. If now the conductor be made to be a vertical column of liquid as, for instance, the part marked "resistor" in Fig. 2, consisting of a hole in a non-conducting material closed at the bottom by the electrode and filled with the liquid, then these forces will act horizontally and perpendicularly to the axis along the whole length.

This force acts on the material constituting the conductor, and for this reason the liquid particles are moved bodily from the circumference to the central axis; hence they create a suction near the periphery and a pressure at the center.

Moreover, by hydraulic action these radial forces should in turn produce corresponding longitudinal forces at the center and at the periphery, and as these axial or vertical forces cannot expend themselves at the bottom, they should do so at the top, thereby producing a veritable fountain, as shown in Fig. 2, the liquid flowing up in the center and down at the periphery, about as shown by the arrows; moreover, the direction of this hydraulic flow is independent of the direction of the electric current, hence is the same for direct or alternating currents.

This phenomenon is admirably adapted to be made the basis of a liquid resistor furnace. If such a column is made the resistor in which the heat is generated by passing the current through it by means of an electrode at the bottom, the heated liquid will be rapidly expelled and forced to the top against the blanket of slag, while the cooler liquid at the bottom will be sucked down into the hole near the circumference to be in turn heated and immediately expelled with considerable force. With energetic circulation through the resistors, the fatal objections to the use of liquid resistors could be overcome.

In practice one would naturally use two holes, one for each electrode, as

[1] Abstract of paper read at meeting of American Electrochemical Society, New York, April 8, 1911.

that reduces the depth of the hole to one-half. The proportions of the hole, that is, the ratio of the section to the length are of course determined by the resistivity of the material, the amount of heat to be generated, and the relation of the volts to the amperes; the actual dimensions are therefore still a matter of choice. The ejecting force increases with the square of the current and diminishes as the cross section increases. Therefore there is very fortunately some choice left as to the dimensions of these "flowing resistors."

In most materials there is apparently a very rapid rise of resistivity with the temperature, which is very favorable to the proportions of such resistors, as is also the apparently very rapid increase of the specific heat of iron at the higher temperatures.

The advantages of a furnace based on this principle are numerous. It is ideally simple and cheap, consisting merely of a crucible or hearth with two suitable holes in the bottom plugged with the electrodes. The heat is generated in the material itself, which is just where it is wanted; moreover it is generated in the most rational place, namely at the bottom and not on the top surface; it is conveyed and distributed mechanically, so to speak, throughout the melted mass, and this conveyance of heat is immensely more rapid than it would be by mere conduction or by the slow flow due to differences of density; hence a charge is treated and finished rapidly, whereby the output of the furnace per day is increased and the losses of heat per ton are proportionately reduced. As far as is known now, there is no temperature limit except that of the failure of the refractory lining, as the pinch effect can no longer limit the temperature.

This very active agitation and circulation of the liquid mixes the product rapidly with any of the refining ingredients which may be added, and tends to make the product very homogeneous. Every particle of the liquid is in turn, and repeatedly, brought to the surface where mechanically suspended impurities and gas bubbles are expelled or forced into the slag, and where the metal is exposed to the chemical action of the slag, which is so desirable and important in the refining of steel; the fresh and highly heated surfaces thus exposed to slag action are of course enormously greater than in a still bath. The top surface of the metal may be made as large as desired. The temperature at the surface of contact of metal and slag, on which temperature the slag action depends, is maintained better when the heat flows up naturally from the hot metal to the cooler slag, than when it flows down from the hotter slag to the cooler metal.

Other advantages lie in the fact that the electrodes are very cheap, are not consumed, and as they may be made of metal they are far more economical in energy loss than carbon or graphite would be. No moving and adjusting of

FIG. 1.

the electrodes are required. The interior of the furnace may be made as small as the quantity of material requires, hence the thermal efficiency of the walls of such a furnace could be made to reach the practical maximum of all types of furnaces. Moreover, as the heat is rapidly distributed mechanically throughout the mass, the maximum temperature need be no higher than that required for the desired met-

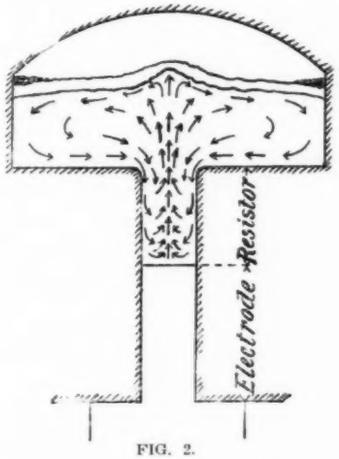


FIG. 2.

allurgical or chemical action, hence the heat losses, which increase so rapidly with the temperature, are correspondingly reduced; in this is a great advantage over arc furnaces, in which the temperature is necessarily that of the vapor of carbon, hence immensely higher than what is needed.

The regulation is simple, rapid, and ideal; the resistance does not change appreciably with varying amounts of metal in the hearth; the resistance of the resistor, as determined by the voltage and amperage, may perhaps in some cases be an indication of the progress of the metallurgical treatment and, owing to the very rapid circulation, one can feel sure that the treatment is uniform throughout the whole mass.

The hottest liquid is that in the center of the resistors and is therefore not in direct contact with the refractory lining. The rapid flow is not along the walls of the hole, but in the center, where it, of course, causes no wear. Whatever friction there is, converts the mechanical energy into heat, and is therefore not lost.

The counter electromotive force which must necessarily be generated by the movement produced, is an advantage as it shortens the resistor, and the energy corresponding to this counter electromotive force, also ultimately generates heat by friction, and is therefore recovered. Some of the electrical energy is therefore converted first into motion and then into heat.

By using a bath of some suitable metal in the bottom of the furnace as the prime receiver of the heat, the furnace is adapted to melt non-conductors like glass, or to heat granular ores, reduce and volatilize such metals as zinc and arsenic from their ores, etc. By dissolving carbon in the iron in one part of a bath and the oxide in another part, iron can be reduced from its ores, and the carbonic-oxide gas produced can be burned to preheat the ore, whereby the total energy of the carbon may be utilized.

When badly proportioned the columns are likely to pinch off, causing rapid makes and breaks; this so greatly reduces the amount of heat which can be generated, that there is danger of freezing. Such repeated breaking of the circuit should be avoided. Several times a charge was left to freeze in the furnace over night and yet was readily started the next day from the cold state, thus showing that the resistors do not part in shrinking.

An interesting feature of the principle on which this type of furnace is based is that, contrary to the more usual causes, the larger the furnace the better, and the less will be the difficulties, because the resistors then become shorter and thicker.

This new principle naturally opens up a new field and there are many modifications which at once suggest them-

selves. It would be quite simple, for instance, to add gaseous fuel heat, or the heat of an arc, in the upper part; or to add the electrical parts to existing open-hearth or other furnaces and use the electric heat only for the final treatment.

The transformer is best attached directly to the bottom or side of the furnace, as the furnace currents are, of course, of low voltage, hence large in amperes. The flexible connections to a tilting furnace then consist merely of the two thin primary wires. The furnace is readily adapted to three-phase currents; the only change is that there will be three holes and electrodes instead of two.

The following is a list of some of the objectionable, troublesome or undesirable features of arc, induction, and simple resistance furnaces with liquid resistors, and it will be seen that they would all be avoided, or at least lessened, in the present type of furnace.

Among the disadvantages of arc furnaces may be mentioned the following: the handling, feeding and adjusting of the electrodes; their cost, because they are consumed; the breaking off of their ends in the furnace; the handling of the hot stubs; the difficulty and expense of making good connections with the terminals outside of the furnace, through which terminals the electrode must be capable of being moved; the water cooling of these movable terminals above the furnace; hence the possible danger of water running into the furnace; the wasting away of the electrodes on their sides; the contamination of the product by the material of the electrode which cannot be of metal; the carbonaceous atmosphere; the necessarily high temperature, and the consequent additional losses through the electrodes and the roof of the furnace; the unnecessarily large inside volume of the furnace, which increases the losses; the heat is applied at the top, hence travels down chiefly by very slow conduction, aided somewhat by a local agitation immediately under the arc; there is therefore no gravity circulation, hence the distribution of the heat is necessarily very slow and uneven; the heat must pass through the slag, which is a bad conductor, to the metal, which is a good conductor; this means greater loss of heat per pound of product, and a larger furnace; complications arising when three-phase currents are used; the difficulty in regulating the current of an arc, and the cost of apparatus for doing so; the troubles when the arc goes out; the attention required to prevent this; an arc furnace cannot well be used for zinc, arsenic, glass, etc.

Among the disadvantages of induction furnaces may be mentioned the following: the cost; the bad power-factor; the necessarily poor heat insulation; it must be dismantled to start cold; the necessity of retaining a large part of the charge for starting the next run, or it must be started with a relatively large part of the charge heated elsewhere; the limitation of temperature by the construction and by the pinch phenomenon; the maximum temperature may therefore not be high enough for some purposes, as, for instance, for the melting of aluminum; all of the charge conducts the current, hence the charges must be small or the possible variations of the current very great; unequal heating when not perfectly level; no very active longitudinal circulation, hence the chemical actions are slow, involving a smaller output per day and therefore a greater heat loss per pound; no large open space for slag action, except by introducing complications; these require additional current to be introduced by means of electrodes, and the difficulties then arise of getting rapid circulation, as well as some of the other troubles of electrode resistance furnaces which it was the very purpose of the electrodeless induction furnace to eliminate; expensive complications when three-phase currents are used; and also the difficulty of good insulation of the high-tension current.

Among the disadvantages of resistance furnaces having electrodes and containing fused material may be mentioned the following: serious limit of temperature and speed of heating due to pinch phenomenon; contamination of the product by the material of the electrode if carbon or graphite; great changes of current required with increasing quantities of reduced materials; hence small charges or very great regulation; small slag surface in narrow channels, or if channels connect with a large hearth, then the difficulty of getting rapid circulation from the heating channel to the hearth; the cost of apparatus for doing the same; complications with three-phase currents.

Electrification for Berlin.

The electrification of the Stadtbahn, the great suburban railroad crossing the center of Berlin, Germany, was the subject of a recent active discussion between Railway Minister Breitenbach and Finance Minister Lentze. The conclusion was reached that the proposal of electrification was entirely practicable from both financial and technical points of view.

The Stadtbahn does an enormous passenger business, its trains running from two to five minutes apart and the plan for better operation has long been in abeyance, owing to fear of the cost. This was originally estimated at 250,000,000 marks ($62,500,000), but now the estimates have been cut down to 120,000,000 marks ($30,000,000). A bill to carry the plan into effect will probably be introduced at the next session of the Prussian diet.

Electrification of Vienna Suburban Railway.

A recent dispatch from Vienna, Austria, states that the city council has approved the project to spend $20,000,000 on the extension of the suburban railway, including the replacing of steam by electricity as motive power, the building of branch lines linking the main railway stations, and also of new underground lines bisecting the city in two directions. The cost, which is to be spread over a number of years, will be contributed jointly by the state, the province and the municipality.

A New Plant for Fixing Nitrogen.

The Pauling process for making nitric acid by the fixation of atmospheric nitrogen is being applied at a new plant in La Roche, France. Electric energy for the process is developed from water power by four turbo-generators of 2,000 horsepower each. The furnaces are arranged in groups of three, and each has two arcs in series. Fifty-cycle, three-phase current is used at 6,000 volts. Each furnace uses one phase.

The air is preheated and compressed before entering the furnace. On leaving it, the gases have a temperature of about 1,000 degrees centigrade and contain from 1.1 to 1.5 per cent of NO. On cooling, the latter reacts with the oxygen to form NO_2. This is absorbed by the water in absorption towers through which the gases pass.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

AMERICAN CITIES RAILWAY COMPANY.

The American Cities Railway & Light Company has issued its full pamphlet report for the year ended December 31, 1910. The income account compares as follows:

	1910.	1909.
Total income	$893,185	$714,244
Expenses and taxes	40,967	28,082
Net earnings	*852,217	686,162
Preferred dividends	414,366	414,366
Common dividends	430,444	269,027
Surplus	7,407	2,769
Previous surplus	556,924	304,155
Special income	100,000	250,000
Total surplus	664,332	556,924

†Special income from earnings of previous years.

*After allowing for full six per cent dividends on $6,906,177 preferred stock, the balance, $437,452, is equal to 4.06 per cent on $10,761,165 common stock as compared with 2.53 per cent earned on same stock previous year.

The combined income account of the companies controlled by the American Cities Railway & Light Company for year ended December 31 follows:

	1910.	1909.
Gross	$6,503,114	$5,801,238
Expenses and taxes	3,721,469	3,360,944
Net	2,781,645	2,440,293
Interest and sinking fund	1,340,833	1,277,041
Surplus	1,440,811	1,163,251
Dividends	997,477	799,433
*Net surplus	443,334	363,818

*American Cities Railway & Light Company's proportionate share of above undivided surplus earnings: For 1910, $403,780; for 1909, $328,015; for 1908, $259,686.

NEW YORK EDISON COMPANY.

The New York Public Service Commission has issued a report covering operations of the New York Edison Company, for the year ended December 31, 1910, which compares as follows:

	1910.	1909.
Operating revenue	$18,051,106	$16,553,257
Operating expenses, taxes, etc.	10,685,241	9,810,555
Operating income	7,365,864	6,742,702
Other income	1,150,509	1,004,030
Total income	8,516,374	7,746,732
Interest, rents, etc.	2,695,060	3,026,925
Net income	5,821,346	4,719,807
Dividends	2,897,100	2,703,060
Surplus	2,924,246	2,016,747
Previous surplus	16,930,453	14,835,547
Profit and loss adj. (cred.)	527,140	78,159
Profit and loss surplus	20,381,839	16,930,453

WESTERN ELECTRIC COMPANY.

Sales of Western Electric Company in March were ten per cent larger than for the same month a year ago. For the first quarter of its fiscal year to April 1 the company has done eleven per cent more business than in the same period a year ago. There has been some letting up in orders in the East, but sales in the middle and far western states continue excellent.

Western Electric is now employing 25,000 persons, compared with 23,464 on January 1. The present number is within 4,000 of the largest payroll the company ever had.

The present policy of the Western Electric Company is to look for increased profits through reduction in cost of manufacturing rather than by increases in selling prices. It has made practically no advances in prices and in numerous cases has been steadily lowering the price, sharing reductions in cost of production with its customers.

TRI-CITY RAILWAY.

The pamphlet report of the Tri-City Railway & Light Company for the year ended December 31 last states that the increase in gross earnings was equal to 23.24 per cent; in operating expenses and taxes 29.89 per cent and in net earnings 14.79 per cent, while the gain in surplus was equal to 59.97 per cent, as compared with 1909. The income account compared with the previous year is as follows:

	1910.	Increase.
Gross earnings	$2,513,487	$473,999
Operating expenses and taxes	1,481,967	341,060
Net earnings	$1,031,520	$132,939
Interest and discounts	481,408	9,020
Balance	$ 550,112	$123,919
Sinking fund installments	50,000	.....
Balance for dividends	$ 500,112	$123,919
Preferred dividend	$ 169,572	.....
Surplus	$ 330,549	$123,919

CANADIAN WESTINGHOUSE COMPANY, LTD.

The Canadian Westinghouse Company, Limited, has issued its report for the year ended December 31, 1910. The income account compares as follows:

	1910.	1909.
Net earnings	$ 697,393	$ 498,379
Depreciation and invoice adjustments	130,000	70,000
Balance	*567,393	428,379
Dividends	306,362	261,540
Surplus	261,031	166,839
Previous surplus	536,104	431,724
Total surplus	797,135	598,563
Written off prop. and plt. account	70,522	62,461
Profit and loss surplus	726,613	536,103

*Equal to 12.9 per cent earned on $4,376,600 capital stock, compared with 10.1 per cent earned on $4,224,600 capital stock last year.

UNITED TRACTION OF ALBANY.

The report of the United Traction Company, of Albany, for the quarter ended December 31, 1910, compares as follows:

	1910.	1909.
Total operating revenue	$599,807	$537,801
Total operating expense	381,052	327,192
Net operating revenue	218,754	210,608
Taxes accrued	37,577	24,069
Operating income	181,176	186,538
Other income	56,335	45,354
Gross income	237,511	231,892
Total deductions from gross income	106,170	94,620
Net corporate income	131,341	137,271

BELL TELEPHONE OF MISSOURI.

The Bell Telephone of Missouri reports for the year ended December 31, 1910, as follows:

	1910.	1909.
Revenue	$2,068,245	$1,984,156
Expenses, taxes, maintenance, etc.	1,491,526	1,273,586
Net revenue	576,526	710,570
Dividends	.....	703,040
Surplus	.....	7,530

WESTERN UNION TELEGRAPH

The Western Union Telegraph Company has issued its preliminary estimated statement of earnings for the quarter ended March 31, 1911. These estimated earnings compare with actual figures for the same period of 1910 as follows:

	*1911.	1910.
Net revenue	$1,470,000	$1,794,998
Bond interest	433,062	433,062
Balance	1,036,937	1,361,936
Dividends	747,840	747,711
Surplus	289,097	614,225

*Estimated.

The actual figures of the Western Union Telegraph Company for the quarter ended December 31, 1910, compare as follows:

	1910.	1909.
Net revenue	$1,760,809	$1,747,200
Bond interest	443,063	433,063
Balance	1,327,746	1,314,137
Dividends	747,802	747,639
Surplus	579,944	566,498

The earnings of the Western Union Telegraph Company for the nine months ended March 31, 1911 (actual to Dec. 31, 1910) compare as follows:

	1911.	1910.
Net revenue	$5,171,875	$5,471,473
Bond interest	1,299,186	1,299,186
Balance	3,872,689	4,172,287
Dividends	2,243,412	2,243,201
Surplus	1,629,277	1,929,086

CANADIAN GENERAL ELECTRIC.

The annual report of the Canadian General Electric Company, Limited, for the year ended December 31 last says: "Business contracted during the year was satisfactory, both with regard to volume and price. The unfinished business upon which no profit whatever had been taken into account is carried forward to the current year to the value of $4,000,000 and orders are still being received in satisfactory volume."

The income account compares as follows:

	1910.	Increase.
Profits	$ 911,208	$285,218
Depreciation	188,088	96,995
Interest	76,820	25,160
Total deductions	$ 264,908	$122,155
Balance	$ 646,300	$163,063
Dividends	494,624	25,624
Balance	$ 151,675	$137,439
Previous surplus	1,829,000	14,237
Total surplus	$1,980,676	$151,676

CENTRAL UNION TELEPHONE.

The Central Union Telephone Company, the Bell subsidiary company operating in Indiana, Ohio, and southern Illinois, reports for the year ended December 31, 1910, compares as follows:

	1910.	1909.
Gross	$5,597,240	$4,999,424
Operating expense	4,112,416	3,636,062
Net	1,484,824	1,363,362
Charges	1,482,947	1,363,272
Surplus	1,877	90
Previous surplus	1,353,399	1,353,309
Total surplus	1,355,276	1,353,399

The American production of copper in the year 1909 was 1,092,951,624 pounds, valued at $142,083,711.

New Electrical and Mechanical Apparatus and Appliances.

New Oil-Break Switches.

The modern tendency in the electrical field has been towards the use of apparatus of larger and larger capacities. This has necessitated the development of devices capable of opening large currents at high voltages without introducing disturbing effects on the system. Since the oil-break switch is the only known commercial device which will accomplish this, a discussion of a new form which the General Electric Company has recently developed to meet the requirements in modern large-capacity stations employing voltages from 22,000 to 110,000 will be of interest.

The body of the switch consists of a heavy boiler-iron tank. This contains the oil and also supports the switch leads and operating parts. The tank rests directly on the floor and no cells or barriers are required. The switch is built in single-pole elements, *i. e.*, a three-pole switch consists of three elements, each element constituting a cell in itself. This reduces the floor space necessary and obviates the cost of constructing cells to contain the switch.

In general the construction of these switches is similar to that of the other Form K oil-break switches made by the General Electric Company, in that they have a vertical motion of the contact rods and a double break for each circuit. When the switches are opened the contact blades move rapidly downward, opening the circuit in oil. The switches have ample air space above the oil and are suitably vented to prevent oil from being thrown out when the switches are opened on extreme overload or short-circuit.

With the exception of some of the lower voltages, where one-piece porcelain bushings are used, all bushings are of the built-up type, similar to those which have been successfully used for some time on the General Electric 45,000-volt oil-break switch and on high-voltage transformers. The built-up bushings have porcelain ends, intermediate rings of compound, with treated-fiber washers between the latter. The washers are of large diameter and increase the creepage surface. The bushings after assembly are filled with special insulating compound.

The design of the contacts is such that on rupturing the circuit, the arc always takes place on the upper extremity of the moving contact and on the flared portion of the stationary one, so that the actual current-carrying contact surfaces are always protected.

At rated loads the switches have a low temperature rise, in no case exceeding twenty-eight degrees centigrade.

The switches can be operated by hand, by a solenoid mechanism requiring a direct-current source of power, or by a diaphragm mechanism using compressed air, and are arranged for either non-automatic or automatic operation on overload. The weight of the moving parts is counterbalanced by adjustable tension springs, so that the switches close easily and open without excessive jar.

300-AMPERE, 45,000-VOLT OIL-BREAK SWITCH.
Hand operated with series-relay mechanical trip.

The hand mechanism consists of a handle or operating lever mounted on a panel or other suitable support. In closing the switch the lever moves through an arc of 180 degrees. It has a very powerful toggle which exerts the maximum power at the end of the stroke and makes it possible to close the switch contacts under heavy spring pressure. On all non-automatic mechanisms, provision is made for adding overload protection at any time without difficulty. The mechanism for overload operation has a trip, free from the handle feature, so that the switch cannot be held closed on overload or short-circuit.

For solenoid operation the operating handle, bell cranks and pipe connections are replaced by one or more solenoid mechanisms, each of the latter being provided with a large coil to close the switch and a small coil to trip it. A control relay is used to close and to open the closing-coil circuit, the control switch thus having to handle the small current of the control-relay coil only. The trial coil of the solenoid-operated switch is energized by a hand-operated control switch or by an overload circuit-closing relay when used. Solenoids are made for use on 125, 250, and 650 volts, direct-current.

For remote control, where a convenient source of direct current for operating the switch is not available, air-operated mechanism can be used.

To provide for the automatic protec-

tion of apparatus, under abnormal conditions of overload or short-circuit, two methods, series relays and current transformers, are commonly employed. A selection between them and the various combinations under each, depends upon the conditions of operation in the particular case as well as upon the cost of installation.

Series relays are similar to standard switchboard relays with or without bellows attachment for instantaneous or time-limit operation respectively. They are all single-pole, and each is mounted on a post insulator. The post insulator is clamped to a base, which may be mounted on the side wall of the station or to a support directly above the switch. The relays are connected in series with the line, one or more being

SINGLE ELEMENT OF SOLENOID-OPERATED OIL-BREAK SWITCH.
100 Amperes, 110,000 Volts.

used, according to the system employed.

Series overload relays with mechanical trip with or without the inverse time-limit feature are used with hand-operated switches where a convenient source of direct current for tripping is not available. The relay mechanism acts directly through a treated wooden rod and tripping shaft upon a small auxiliary toggle which releases the main-switch toggle and opens the oil switch.

The series overload relay with electrical trip is similar to the ones just described except that the wooden connecting rod actuates a small switch and closes an electrical circuit through a trip coil which in turn opens the oil switch. This method of tripping is used with solenoid-operated switches. It may also be used with the air-operated switches, being connected in a manner similar to that just described, except that low-tension alternating current is used to actuate an electrically operated air-control valve.

High-voltage current transformers, when accurate and reliable, are more expensive than series relays, and are therefore seldom used for tripping switches except when it is necessary to use the current transformers with watt-meters, watt-hour meters, or reverse-current relays. In general the operation of these switches by means of current transformers is the same as with lower-voltage apparatus using standard switchboard relays, and varies only in the combinations for the different operating mechanism.

The "K-10" switch is used on systems with voltages of from 22,000 to 110,000 volts, on which the combined normal energy delivered to the bus is not greater than 20,000 kilowatts. The "K-15" oil switch is used on systems with voltages of from 70,000 to 110,000 volts on which the combined normal energy delivered to the bus is not greater than 50,000 kilowatts.

New Building for Electric Storage Battery Company.

The Electric Storage Battery Company has closed a contract for the design and construction of a new reinforced concrete building which will be the largest manufacturing building of this type in Philadelphia.

This addition to its present plant will be a building approximately 300 feet long by 115 feet wide, six stories high, with a one-story triangular extension about 80 by 120 feet. The building will utilize the patented system of Mushroom reinforced-concrete construction and will be designed to meet the particular demands of the company.

The demand for storage batteries of this company's manufacture has increased to such an extent that it has been necessary to provide additional manufacturing facilities at once.

The new building will be of the most up-to-date design, strictly fireproof, and will be provided with the most modern machinery and the best facilities for the convenience of its employees. The construction is to start at once and will be completed during the fall.

Large Condensing Equipments.

The Wheeler Condenser & Engineering Company, of Carteret, N. J., has recently been awarded the contract for building five large and notable surface-condensing equipments for prominent public service plants.

The condensers proper will all be of the Wheeler dry-tube type, in which the tubes are so grouped as to secure the best distribution of the steam, and drain plates are interposed at numerous levels in the condenser to prevent steam condensed in upper parts of the shell, falling upon and flooding tubes in the lower part. The drain plates also carry off the water of condensation to the hotwell, without bringing it into contact with tubes and thus insuring a high hotwell temperature with a corresponding saving in heat.

Three of these dry-tube condensing

SINGLE ELEMENT OF PNEUMATICALLY OPERATED OIL-BREAK SWITCH.
100 Amperes, 110,000 Volts.

equipments will be for the Waterside No. 1 plant of the New York Edison Company, and will consist of circulating, hotwell and vacuum pumps, together with specially designed base condensers to operate in connection with three 20,000-kilowatt turbo-alternators.

These special condensers will have a rated capacity of 300,000 pounds of steam per hour, and will be the largest of their kind in the world.

The other two condensing equipments will be for 10,000-kilowatt turbines to be supplied for the new power station of the Minneapolis General Electric Company.

Seaboard Air Line Adding to Its Telephone Train Dispatching System.

The Seaboard Air Line Railway is placing orders with the Western Electric Company for telephone train dispatching equipment covering more than 600 miles, with two complete circuits. This installation is being made as a direct result of the increased economy of the telephone over the telegraph as experienced by over a year and a half of service on divisions extending from Richmond to Raleigh, with a branch to Portsmouth, Va., and from Raleigh to Monroe, N. C.

The first new division being equipped centers at Hamlet, N. C., and extends in one direction to Wilmington, a distance of 111 miles, from Hamlet south to Columbia, 106 miles; and west to Rutherfordton, 157 miles, making a total of 374 miles, equipped with thirty-six stations.

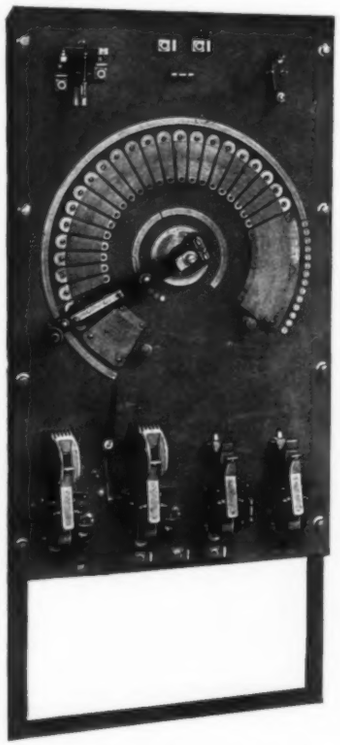
The second division extends from Jacksonville to Tampa, with branches to Orlando and Venice, Fla., 265 miles in all, on which will be installed thirty-eight way-station equipments. The dispatcher, in this case, will be located at Jacksonville, and it is intended to operate the branches off the main line by means of polarized relays. The stations on the branches will be called only when they are desired and the selectors will not be operated when stations on the main line are called.

The equipment to be installed on these divisions is of the latest type manufactured by the Western Electric Company, which installed the present equipment on the Seaboard Air Line

Controllers for Motor-Driven Rotary Printing Presses.

For the control of single motor-driven rotary printing presses, especially newspaper presses, the type of controller illustrated herewith has been standardized in capacities of fifteen to fifty horsepower by the Cutler-Hammer Manufacturing Company of Milwaukee. These controllers give a slow speed of ten per cent of the normal speed, by a combination of resistance in series with the armature, and resistance shunted across the armature. The series resistance reduces the motor speed fifty per cent below normal and accelerates the press under load conditions. The armature shunt resistance is controlled by a solenoid switch, which is energized from the motor-armature voltage when the main controller lever is on one of the first four speed points. Slow speed is adjusted by setting the main lever on one of these points and shifting a small link on the panel to adjust the amount of armature-shunt resistance.

The line circuit to the motor is controlled by a solenoid swtch provided with heavy copper and carbon arcing contacts and a powerful magnetic blowout. This switch is operated from any of the control switches, and is so interlocked with the main-controller lever that the motor circuit cannot be closed unless the proper amount of armature resistance is in circuit. This protects the motor and press from a



PRINTING-PRESS CONTROLLER.

failure of voltage and a subsequent restoration of same. A dynamic brake stops the motor quickly and smoothly whether actuated from the control switches, from the over-load relay or when the main-controller lever is moved to the "off" position. From any of the control switches the motor may be started, run at the slow speed or stopped. When the press is ready to print, the motor can be accelerated to the printing speeds by the main lever of the controller. The press can be stopped by moving the controller lever to the "off" position, by the stopping switch on the controller panel, or from any of the control switches.

Three-Phase Locomotives in Italy.

Recently received information as to the tests of the three-phase locomotives built for the Giovi line of the Italian State Railway by the Societe Italiana Westinghouse makes it timely to present to our readers the results of these tests and a brief description of the locomotives.

The Giovi Tunnel is situated between the stations of Pontedecimo and Busalla on the line between Genoa and Milan. The traffic is very heavy, this being the most important line between Genoa, the greatest shipping center, and Milan, the greatest manufacturing center, of Italy. In addition to general freight and passenger traffic hundreds of cars of coal are daily sent over the Giovi line from Genoa to Milan. Electrification became necessary on account of the impossibility of coping with the increase in traffic with steam locomotives. The artificial ventilation of the tunnel, owing to its great length, could not be improved any more and the condition of the atmosphere in the tunnel was such that an increase in the number of trains or steam locomotives would endanger the safety of the service.

The Italian State Railway after ten years of experience has chosen for the electrification of railway lines the three-phase system at high-potential, fifteen cycles, as adopted in the Valtellina lines and Simplon Tunnel. The first order from the Italian State Railway to the Italian Westinghouse Company was for forty locomotives for freight service, twenty-five of which were for the Giovi line and fifteen for the Savona San Guiseppe line from Savona to Turin, which is being electrified at present. The first locomotives were completed in July, 1908, at the Westinghouse Vado Ligure Works. Upon completion they were employed for a time in the Valtellina lines, pending completion of the Giovi tunnel electrification.

The new Giovi locomotive is built for freight service and has a normal operating speed of twenty-eight miles per hour. It can also be used for passenger service as its speed capacity is as high as it is considered safe to use on the Giovi line. The locomotive has also a fourteen-miles per hour speed, which is intended for switching purposes and for regenerating power when the train is running down hill. The locomotive weight is not more than sixty tons, but the mechanical construction is such

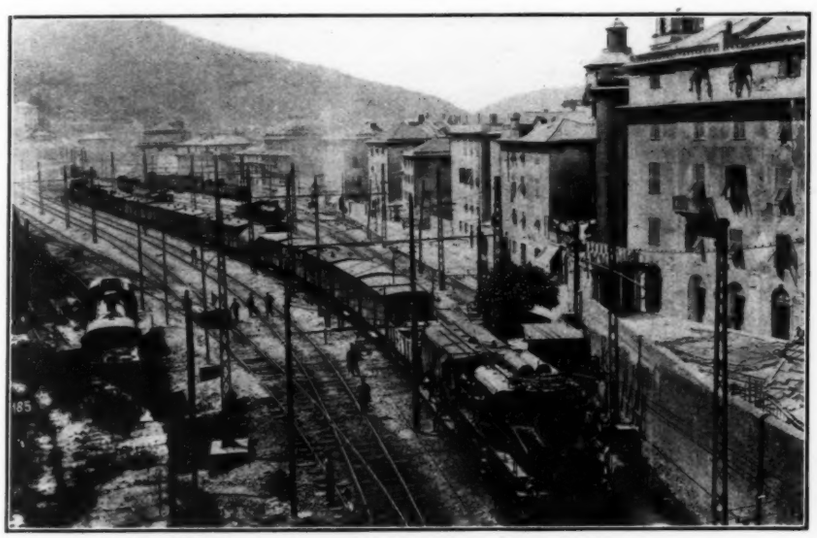
that the weight can be increased seventy-five tons by means of ballast.

During the tests a train of 418 tons, exclusive of locomotives, was taken with a speed of twenty-eight miles per hour from Pontedecimo to Busalla, a distance of 6.5 miles with a maximum grade of 3.50 per cent, an average grade of 2.70 per cent, and a minimum curve radius of 1,200 feet. After this the train was taken back at a speed of fourteen miles per hour, the locomotive being connected for regenerating power. The time allowed for one round trip is 140 minutes. After twenty hours of such continuous operation, one round trip without forced ventilation of the motors was made with a temperature rise of the motors considerably less than seventy-five degrees centigrade. The one-hour motor rating for the same temperature is 720-horsepower per motor corresponding to a locomotive pull at the wheel circumference of 19,500 pounds; during the test this rate was exceeded. The friction rating under most unfavorable conditions is such that a train of 380 tons exclusive of the locomotive, can be accelerated to twenty-eight miles per hour in less than 200 seconds, by two locomotives, one pushing and one pulling on a grade of 3.50 and on a curve of not more than 1,200 feet radius. One locomotive can accelerate a train of 400 tons without locomotive to a speed of fourteen miles per hour of a grade of .3 per cent and 300 tons on a curve of 540 foot radius thirty times in one hour. The maximum starting torque is such that they can revolve the wheels of the locomotive, with its weight increased to seventy-five tons, while the locomotive is kept stationary.

The motors are three-phase, 3,000-volt, fifteen-cycle machines arranged to run in cascade and parallel, giving two synchronous speeds of 112.5 and 225 revolutions per minute. Intermittent speeds are obtained by inserting rheostats in the circuit. The motors have double bearings, the outer of which is built into the main locomotive frame and carries the reactions of the frame; it also takes the thrust of the connecting rods and is provided with springs to take up all the motion or change of position due to shocks, ballast on locomotive frame, etc.

The control system contains a number of excellent features. Since the starting resistances are of water rheostat type it was necessary to design the secondaries of the motors for low potential; this was also desirable in order to have low potential on the slip rings. The low potential secondaries require, however, the possibility of connecting one of the motors in cascade connection.

The switch performing this re-connecting of one of the stators from high to low voltage is the only switching mechanism in the system which has numerous contacts for heavier currents. It can, in this respect, be compared with either the auto-transformer tap switch of single-phase systems and polyphase systems with squirrel cage rotors, or with the resistance distributing switches of systems using metallic starting resistance; but its practical operating characteristics are better.



THREE-PHASE LOCOMOTIVE ON ITALIAN STATE RAILWAY.

The use of the water rheostat is one of the main advantages of the control system. It eliminates all metallic resistance parts, which are always more or less subject to burn-outs and mechanical breakage. Moreover, all contacts that have to be operated under current in the secondary are eliminated excepting the one contact which short circuits the rheostat. On this contact, however, there is no arcing and burning, since it operates only when the water rheostat is about zero. A further advantage of this control lies in the fact that it does not increase the current by steps, but allows for the finest possible regulation.

The only switch that is interrupted under current is the primary switch; but even for this switching conditions are very favorable, as the current to be interrupted in the primary of induction motors with wound secondary may be reduced practically to the magnetizing current by first inserting resistance into the secondary and then breaking the primary current. For this reason it has been possible to use other switches, which after an operation of two years are still in good working condition. The excellent feature of the primary of the Giovi locomotive is that it serves as both an interruption switch and a reversing switch without requiring any additional contacts for the reversing; this is accomplished by simply rotating the moveable contact parts through a certain angle in order to reverse the motor.

The master switch is arranged for two levers. One of the levers has four definite positions corresponding to the two speeds, to move forward and backward. The second lever regulates the current consumed by the motors. Every position of this lever determines positively the certain maximum current to be taken by the motors.

The pantagraph arrangements are very simple. The single bow with two bronze cylinders insulated from each other and revolving in ball bearings engages both overhead wires. The use of the rolling contacts is very favorable for the contact wire, and has given very good results on the Valtellina lines where it has been in use for over ten years.

Wireless-telegraph stations are to be installed on the steamers *Northland* and *St. Helens*, owned by the E. J. Dodge Company, of San Francisco. The United Wireless system will be used.

The Largest Storage Battery in the World.

A contract has just been made by the Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., with the Electric Storage Battery Company, of Philadelphia, Pa., for the installation of an enormous battery to be used for emergency service.

This battery will consist of 152 cells of the "Exide" type, each cell containing 133 plates. Each of the 152 lead-lined wood tanks will be 50 inches high, 21.75 inches wide, and over 6 feet long, and will weigh without plates or electrolyte 940 pounds. The total weight of the entire battery equipped with plates and electrolyte, when ready for service will be approximately 1,079,200 pounds.

This battery when fully charged will supply 3,000 kilowatts for one hour.

A New Pole Climber.

The Roberts patent climber has a number of features which will commend it to the lineman. Being made of one piece of crucible tool steel, the spur cannot loosen. Climbing is therefore made very safe. The spur is long and strong, and is set high enough not to touch the ground when walking. There is consequently no damage to tin roofs when the lineman is compelled to step upon them. The straps are arranged to fit comfortably around the foot, there being no fold to irritate and chafe the skin. The straps cannot be lost from the climber. This climber is put on the market by the Oshkosh Logging Tool Company, Oshkosh, Wis.

ROBERTS POLE CLIMBER.

Duluth & Iron Range Railroad Adopts the Telephone.

The telephone system of train dispatching has been adopted by the Duluth & Iron Range Railroad, and equipment is now being installed between Two Harbors and Ely, with a branch from Allen Junction to Virginia and Eveleth, in Minnesota. The new telephone system will cover 123 miles and there will be fifteen way stations. Western Electric apparatus is being used.

An Interesting Generating Set.

A rapidly increasing tendency toward combining auxiliary apparatus as much as possible into fewer sets of independent units is exemplified by an exciter set recently installed at the Easthampton, Mass., cotton mill of the West Boylston Manufacturing Company. This set consists of a 30-kilowatt Diehl generator furnishing direct current at 110 volts. This generator is direct driven by a 75-horsepower Terry steam turbine at 2,500 revolutions per minute. Beyond the generator, and mounted on the same bed-plate with both the latter and the turbine, is an eight-inch centrifugal double-suction Janesville pump, which may be disconnected by means of a flexible coupling joining the generator and pump shafts.

By operating the turbine twenty-four hours a day it is possibly to obtain three different classes of service from this unit. Throughout the winter the pump, which has a capacity of 1,000 gallons per minute, furnished the hot water for heating the entire mill. The generator during the day is connected on the exciter bus for the main units which generate power for the operation of the mill, and during the night it is switched over on the lighting circuit, so that it has approximately a hundred-per-cent load-factor. During the summer the pump is disconnected.

Even the uses of the exhaust steam from the turbine vary at different seasons. During the heating season it is utilized to heat the water of the mill-heating system, while in summer it is changed over to the feed-water-heater line for heating the boiler feed.

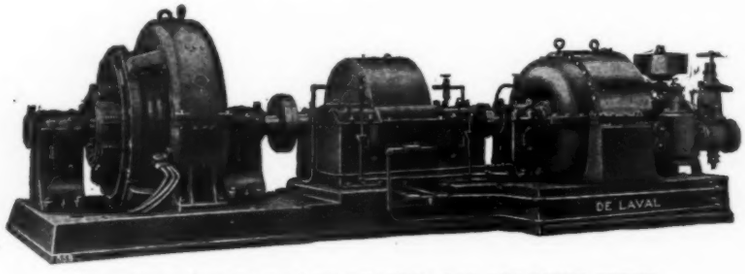
Steam Turbine for Driving Direct-Current Generators.

Steam-turbine builders are constantly making modifications in their machines, nearly all of which are steps in the direction of reconciling the high velocity of the steam-turbine bucket with the more moderate speed at which direct-current generators, pumps, etc., should run. The large size steam turbine has, on the whole, so far found application principally for the driving of alternators and the propulsion of ships.

In view of the pressing nature of the speed-reduction problem, the De Laval multi-stage geared turbine, illustrated herewith, possesses considerable theoretical and practical interest. Helical reduction gears were adopted by De Laval almost at the inception of his work on the steam turbine and have proved entirely satisfactory under service conditions. The efficiency of the double helical gear as made by the De Laval Companies is said to lie between 98.5 and 99 per cent, while the life of the gears is equal to the wearing parts of reciprocating engines.

Experimental work has continued on large gears for stationary turbines, including not only the gear itself, but also suitable machinery for the accurate production of the gears. The need of special effort in this direction is exemplified by the fact that several months of continuous work by a skilled machinist were required for the correction of a lead screw purchased from one of the best shops in this country, before it was considered sufficiently accurate to be used in the gear-cutting machine on which were produced the gears of the machine that is shown herewith.

This unit consists of a multi-stage turbine driving a standard-speed, direct-current Crocker-Wheeler generator through a pinion and single gear, the speed of the turbine shaft being 3,600 revolutions per minute, and the

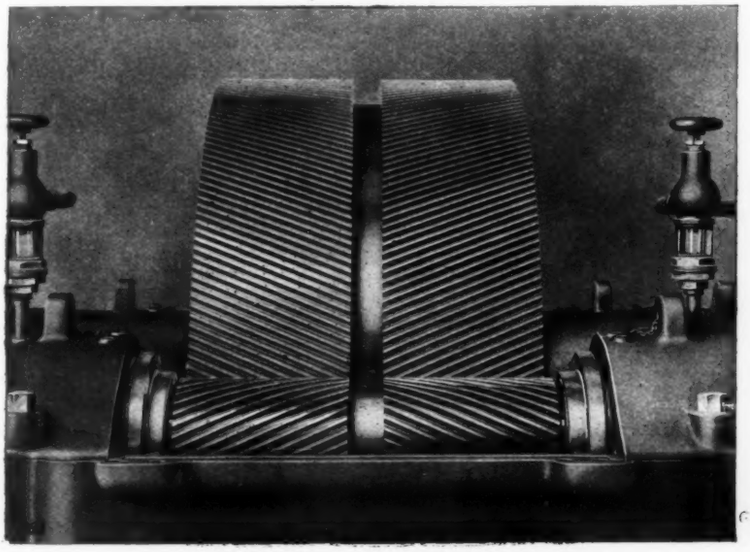


DE LAVAL TURBINE WITH GEARING FOR REDUCING SPEED.

speed of the generator shaft 500 revolutions per minute. The illustration will give a good idea of the compact nature of the construction of the turbine, the maximum capacity of which is 1,200 horsepower.

Steam is admitted to the turbine first through a strainer case and then through a combined trip and throttle valve, to be seen at the extreme right; next through the adjacent governor valve and then, after passing through steam nozzles of the standard De Laval type, impinges upon the blades of the first-stage wheel. Partial admission is used in the first stage, but full admission in later stages. The wheels are of the standard De Laval type, made of such section as to give great strength throughout.

The buckets are set in the rim by a peculiar form of dovetail. The buckets are drop forged from solid bars of non-corrodable metal and are allowed to retain the original smooth, glossy finish imparted by the drop-forging process. The use of a special metal also avoids the rusting which has been the cause of serious annoyance with steel buckets and even with mild nickel-steel buckets, whereas high nickel-steel buckets have shown a tendency to become brittle and to break unexpectedly.



REDUCING GEAR FOR DE LAVAL TURBINE.

The wheels are mounted upon the shaft by split taper sleeves drawn tightly into place by internal nuts in the wheels, and after the wheels are assembled, a lock nut on the shaft serves further to secure them, while rotation of the wheels about the shaft is prevented by a key. The greater blade length required by the increased volume of the steam as it proceeds towards the exhaust is secured both by reducing somewhat the diameters of the wheels and by increasing slightly the bore of the casing.

Upon rebounding from the moving blades the steam again expands by passing between the guide vanes placed all around the periphery of the diaphragm between the first stage and the second stage. These blades are made of "extruded" metal and are fitted onto the cast iron diaphragm. The diaphragm itself is slightly dished in order to increase its strength to withstand pressure, and to complete it a solid-steel band is shrunk over the tips of the guide blades. The steel band is slightly wider than the blades and diaphragm and as adjacent bands touch each other, a complete steel casing is formed which would effectually prevent the possible penetration of parts in case of rupture of the wheels. The center of the diaphragm is perforated for the passage of the shaft and leakage of steam is prevented by a labyrinth packing.

The governing mechanism is in duplicate, that is, there is a speed-regulating governor and a speed-limiting or emergency governor. The former is mounted at the top of a vertical shaft driven by a worm gear from the turbine shaft. It is of an extra heavy, substantial type and controls, through a system of two bell-crank levers and a connecting rod, the movement of a vertical double-seated puppet valve similar to that used on standard De Laval turbines. In order to prevent damage to the valve by overtravel of the governor, a spring is inserted in the connecting rod. The same worm which meshes with the worm wheel on the governor shaft meshes with another worm wheel driving the tachometer, which is supplied as a permanent and regular part of the equipment. The lower end of the governor shaft is connected to an oil pump, supplying the bearings of the machine and the pinion and gear. The emergency governor is located in the end of the turbine shaft itself and is ordinarily not in contact with the trip. Upon touching the latter steam pressure is at once released from underneath a piston, by means of which a toggle gear is released, allowing the combined trip and throttle valve to close under the pressure of the steam in the supply pipe.

The pinion and gear are perhaps the most important and interesting part of the construction. The gear is of the double-helical or herringbone type, differing from the standard gears supplied with De Laval turbines only in size and the fact that but a single gear is used for the largest capacities. The pinion is cut from a solid bar of steel and is carried in plain babbitted bearings supported in a rigid cast-iron frame, which also supports the gear bearings. The pinion bearings are lubricated by sight-feed oilers from the pump system before referred to, the excess oil overflowing to the wells of the gear bearings, which are ring oiled. The gear consists of a solid cast-iron center upon which are shrunk two thick steel rings. The hub is mounted on a stiff shaft, which carries at one end a half of the flexible coupling for connection to the driven machine. The gear, complete with shaft, bearings and coupling are shown herewith.

The lubrication of the gear and pinion teeth is accomplished by jets of oil, directed at the line of contact on the entering side. This oil after use is passed through an oil strainer located in the base of the turbine, then through a cooling and settling chamber and then to the oil well, from which it is again pumped through the circuit.

The operation of the turbo-generator above described is remarkably free from vibration and noise, and as it stands in the test room, supported

upon small screw jacks without other steadying means, it is impossible to tell from a few yards away whether or not the turbine is running without noting moving parts. There is no vibration and no noise that may be overheard at a short distance. The quiet running is attributed to several causes, chief among which is a specially designed gear-cutting machine and the adequate method of lubrication employed.

The generator is of the standard engine type adapted for the speed of 500 revolutions per minute, which is the same as could be used for a belted machine of this capacity. The field consists of eight main poles and eight auxiliary or commutating poles, the commutating poles being connected in series with the armature circuit and so proportioned as to eliminate sparking through all ranges of load.

China's Telephone System Now Giving Service.

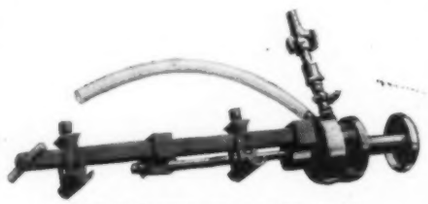
A cablegram has been received by the Western Electric Company stating that the two telephone exchanges which it has been installing in the city of Peking, China, were successfully cut into service on April 2. These exchanges are both of the common-battery type and are equipped for 6,400 lines apiece. At present 3,000 subscribers' lines are connected to this telephone system, which is owned and operated by the Imperial Government.

There have been no adequate telephone facilities in China. The need for a telephone system became so apparent a couple of years ago that an imperial commission was sent abroad to study the telephone systems of other countries. The commissioners were impressed with the facilities and service in New York City and recommended an equipment along similar lines for the Chinese capital. The contract was awarded to the Western Electric Company, after its system had been carefully compared with those of its competitors both in Europe and America. The cost of the original equipment is in the neighborhood of $150,000.

The new telephone system covers the whole of both the Tartar and Chinese cities. Underground cable, 3.5 inches in diameter and containing 400 paper-insulated wires, has been used. The telephone system will employ about thirty operators, all of whom will be Chinese girls.

Commutator-Slotting Tools.

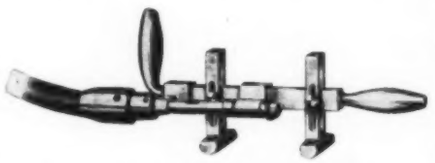
The slotting of commutators is now followed as a general practice by some of the large operating companies, particularly in railway work. In any motor where there is a tendency toward sparking, due to defective design, hard usage or the presence of dirt, the destructive action of the spark causes the burning of the commutator segments at the trailing side. This reduces the level of the copper below that of the mica which, on account of its refractory nature, remains almost unaffected and holds the brushes off of the copper, thus aggravating the trouble. The destructive action once started, proceeds rapidly, precluding good motor operation.



AIR-OPERATED SLOTTING TOOL.

Slotting out the mica to a depth of one-thirty-second or one-sixteenth inch below the surface of the copper makes possible proper contact of the brushes on the bars and, in addition, permits the use of soft brushes, leading to longer life of commutator.

The Westinghouse Electric & Manufacturing Company, Pittsburg, manufactures two types of slotting tools for this purpose, one type air-operated and



MOTOR-OPERATED SLOTTING TOOL.

the other motor-operated. Both types are shown in the accompanying illustrations. Each of the slotting tools comprises a circular saw, with adjustable rests for centering the tool. Guides bearing on the commutator face readjustable on the guide bar of the tool, make it applicable to a large range of commutator sizes. The guides also permit the depth of slotting to be accurately adjusted and maintained.

The air-operated slotting tool is operated by an air turbine at a pressure of forty to eighty pounds per square inch. The air turbine forms part of the tool.

The motor operated slotting tool is satisfactorily operated by a one-fourth-horsepower motor running at approximately 1,700 revolutions per minute. A five-foot flexible shaft is provided for connecting the tool to the motor.

Selectors for Train Dispatching.

The Canadian Pacific Railway is one of the most extensive users of telephone train dispatching on this continent. Its experience is so satisfactory that it has just placed an order with the United States Electric Company of New York and Chicago for 187 additional Gill selectors on its lines east and sixty-eight additional for its lines west, one selector to a station. Other orders of last week for Gill selectors are seventy-four stations for the Seaboard Air Line and eighty-eight stations for the Atlantic Coast Line.

The New York, New Haven & Hartford Leads in Punctuality.

One of the advantages claimed by advocates of electrification of main line roads is reliability of operation. It has been unofficially stated several times recently that the New York, New Haven & Hartford had practically no motive-power delays in handling the entire passenger traffic of its New York end by Westinghouse electric locomotives and multiple-unit trains, notwithstanding the change over from steam to electricity at Stamford.

From reports of train operations in New York State during January, recently given out by the Public Service Commission, it appears that the New York, New Haven & Hartford made the best showing of any road in the state, with ninety per cent of its trains on time. The Long Island follows with eighty-six per cent and the Pennsylvania with eighty-four per cent.

The report is especially interesting in view of the fact that the New Haven is extending its single-phase electrification to its Harlem Division and another branch, and reported as planning extension to New Haven.

Wireless Equipment for Canadian Ships.

Arrangements are being made to equip the steamships *Guiana*, *Parima*, and *Kerona*, of the Quebec Steamship Company, and the Chalmette of the Southern Pacific Steamship Company, with the United Wireless Telegraph apparatus.

Current Electrical News

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

The Commission has authorized the Wisconsin Electric Railway Company to issue $83,000 par value of five-per-cent, twenty-year, first-mortgage gold bonds. These bonds are to be issued in denominations of $1,000 each. The bonds are to be issued and sold for the purpose of supplying the company with funds to pay for the purchase of an electric railway property and equipment; to pay for the cost of extensions and improvements to the property; to provide funds for the payment of outstanding indebtedness incurred by reason of the purchase of electric railway property and equipment; and to provide for working capital.

The Milton & Milton Junction Telephone Company applied to the Commission for an increase in rates, assigning as a reason for the increase the increased cost of labor and materials and supplies. The company wished to raise individual business lines from $1.50 to $2.00; four-party business lines from $1.00 to $1.50; rural lines from $1.25 to $1.50. Residence rates were not changed. The investigations made by the Commission showed that the company had never kept any depreciation account prior to last year. As a result of this negligence the renewal requirements will undoubtedly exceed the amount allowed for depreciation. The Commission states in its decision, however, that this fact does not justify the company in loading its past depreciation cost on the telephone users of the future. It was found that the proposed rates would give too high a return on the investment and the Commission stated that the proposed increase in rural-line rates was hardly justified by the cost of this service. It was suggested that the rural-line rates be kept at the old rate. The other rates the Commission permitted the company to put into force as desired.

The petition of the Troy & Honey Creek Telephone Company for an increase in rates was denied by the Commission chiefly because of the poor condition of the accounts and records of the company. The company asked for an increase in the rate of $1.00 per month for business and residence telephones to $1.25 and $1.50 for residence and business telephones, respectively. Considerable opposition to the increase was developed at the hearings and the subscribers insisted that the petition of the company should not be granted because of the poor service given and it was also claimed that under efficient management the company could earn a reasonable return on the investment under the existing rates. It appeared that the company has never maintained a depreciation account but has always charged all costs of renewals and replacements into the operating expenses. It was found impossible in the condition of the books to separate the renewals thus charged from the operating expenses proper. It developed at the hearings that the company did not maintain its lines in good condition; that the lines were often down and the poles in bad condition. The Commission was rather inclined to the view that the increase should perhaps be granted but stated in its decision that the explanation of the company's condition was so indefinite and the situation with respect to the adequacy of the service so questionable that it was not advisable to pass upon the question at the present time. The Commission held out the hope that when the company has properly adjusted and kept its accounts and has placed itself in a position to render adequate service the Commission would consider the reopening of the case.

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

The Brooklyn Heights Railroad Company, the Nassau Electric Railway Company and the Coney Island & Brooklyn Railroad Company, subsidiary corporations of the Brooklyn Rapid Transit Company, have taken out writs of certiorari to review the action of the Public Service Commission in giving the Manhattan Bridge Three-cent Line a certificate of necessity. One of the grounds of the Brooklyn Rapid Transit's complaint is that the new line proposes to operate over streets in both boroughs already occupied by street car tracks and to cross important junctions. Horse-car lines at present occupy some of the streets in Manhattan on which the three-cent line wants to operate. The Brooklyn Rapid Transit alleges that the three-cent line cannot obtain the necessary consents of property owners.

The long series of hearings in the Long Acre Electric Light & Power Company which have been going one before the Public Service Commission of the First District concluded with the testimony of John W. Lieb, Jr. The application of the company is for permission to issue $10,000,000 additional stock of the company and $50,000,000 bonds. Mr. Lieb submitted a statement to the effect that the New York Edison Company has ample capacity reserves and margin to meet all future contingencies that may arise in requirements for electric light and power in the boroughs of Manhattan and the Bronx; that competition in public utilities is undesirable; that the public interests would not be benefited by competition and that two or more companies would finally result in an amalgamation later. It is also contended by the New York Edison Company that inasmuch as the franchise of the Long Acre Company has not been exercised the franchise has lapsed and is void.

The Public Service Commission and the Subway Committee of the Board of Estimate have received from the Brooklyn Rapid Transit Company definite assurance of the willingness of that corporation to operate a through subway route in Manhattan and the Bronx, laid out on the lines of the Triborough subway. Informal assurances were received some time ago of the company's willingness to have the Triborough subway system, including the Fourth Avenue route, added to its Brooklyn extensions proposed several weeks ago, and enter into the competition for through traffic in Manhattan and the Bronx.

The Public Service Commission, Second District, has caused to be reopened the complaint of the Postal Telegraph Cable Company against the Western Union Telegraph Company. The complaint averred that the Western Union Company charged the Postal Company for the transmission of certain words added to a telegram transferred by the Postal to the Western Union, such words being the name of the transfer point and the date, preceded by the word "via." In its answer the Western Union admitted the making of this charge, and a hearing upon the complaint was had, upon the theory that a charge was made for the transmission of such words by the Western Union. In the briefs filed, however, the Western Union now claims that no charge is made for these words placed upon a transferred telegram, and claims, on the other hand, that a charge is made for the name of the original point and the original date of the telegram. The Commission in reopening this case says that if this position is taken, a different issue is presented from that raised by the complaint and answer, and a further hearing will be had so that proof may be given as to what words the respondent does charge for upon transferred telegrams.

The Commission, Second District, has also received a complaint from William S. Massoneau, president of the village of Red Hook, Dutchess County, directed against the Red Hook Light and Power Company. Because of a dispute as to the amount to be paid for street lights during the last six months of 1910, the company served a notice upon the village that if the amount was not paid by March 31, the street lights would be shut off, and the streets of the village are now left in darkness. The Commission is asked to require the company to at once renew its street lighting service and to continue the same without interruption pending the adjustment of the disputed bill.

COMMISSION NEWS FROM NEW JERSEY.

(Special Correspondence.)

The Board has dismissed the complaint of the Seventh Ward Improvement Association of Jersey City against the Public Service Railway Company, in regard to service from the Pennsylvania Railroad ferry to Greenville. The complainant alleged that the company refuses to issue transfers to passengers for Greenville who may, by mistake, board a car marked "Culver Avenue." The Board finds that the company affords a greater number of cars between the ferry and Culver Avenue than it does between the ferry and Greenville (the district beyond Culver Avenue being less thickly settled). The Board considers that the issuing of transfers at Culver Avenue would tend to the overcrowding of short line cars and cause inconvenience and discomfort to passengers on the short line. The transfer would not hasten the journey of Greenville passengers, as such would be obliged to wait at Culver Avenue for the Greenville car, which could be as conveniently taken at the ferry or at points between the Ferry and Culver Avenue. Opinion is expressed that the fact that persons make mistakes in boarding cars properly marked is not a good reason why they should be transferred, free, to other cars. The duty rests upon the traveler of choosing the proper car route to reach his destination and the company cannot be held responsible for travelers' mistakes.

The Board called a conference with the electrical street railway companies, for Friday, April 21, at its offices in the State House, Trenton, N. J., upon the following: (1) track and roadway, with special reference to bridges, trestles, protection of same, curves and track construction; (2) grade crossings of electric railroads with those of steam railroads; (3) station or waiting room facilities at transfer points; (4) car equipment, with special reference to brakes, fenders and headlights; (5) rails and gates for the protection of passengers when crossing bridges, trestles, passing around curves, etc.; (6) car signs, showing route and destination; (7) standard regulations for government of conductors and motormen.

IMPORTANT DEVELOPMENTS.

POWER PLANT AT TALLULAH FALLS, GA.—In connection with the waterpower development of the Tallulah River a dam 110 feet high is to be constructed, and a total head of 600 feet will be secured at the plant. Water is to be carried through tunnels from the dam to the power house, a distance of about one mile. Approximately 60,000 horsepower will be developed.

A 90,000-HORSEPOWER PLANT.—The new hydroelectric plant which is to be installed at Long Lake, twenty-nine miles down the Spokane River from Spokane, Wash., will develop a total of 90,000 horsepower. The weight of the four wheels is estimated at 1,000,000 pounds. A 170-foot head of water is required to operate the new plant and to reach this a dam, 180 feet in height, 375 feet in width and 150 feet at the base, tapering to 15 feet at the top, will be constructed. The company expects to have the first unit of 45,000 horsepower in operation before the close of 1912. The preliminary work on the dam is under way.

TO ELECTRIFY EASTERN PENNSYLVANIA.—About sixty electric companies have applied to the governor of Pennsylvania for charters, a step which is said to be in the way of a general electrification. The Lehigh Coal & Navigation Company is back of the project, which aims to supply with power all of Eastern Pennsylvania, affecting a territory with a population of 2,500,000 people, including Philadelphia. The power will be transmitted over main high-tension lines more than 130 miles long, with branches to all industries, towns and villages that will contract to utilize the power.

GOVERNMENT TO DEVELOP NEW-MEXICAN PROJECT.—The board of governors of the Elephant Butte Water Users' association and the El Paso Valley Water Users' association decided at a joint meeting that was recently held in El Paso, Tex., that the hydroelectric feature of the Elephant Butte dam and reclamation project shall be developed and put into effect by the federal government instead of by a private power company. The proposition on behalf of the company that has been in process of formation for some time was submitted to the meeting by Richard W. Burges, an attorney of El Paso. Mr. Burges' proposition was to lease the power rights of the Elephant Butte dam for a period of fifty years to a company to be known as the Rio Grande Power Company, which proposed to utilize the power generated at the dam and elsewhere in the project to operate an electric railway and supply power to towns and industrial enterprises in the upper Rio Grande valley. The men who oppose this plan stated that the federal-government reclamation service is in better position to develop the power possibilities of the project than any private company that might be organized for the purpose. J. A. French, engineer of the reclamation service, was present at the meeting and made the statement that the government is proceeding with plans for the development of the power that the dam might afford and that the hydroelectric plant would be installed at the same time the irrigation feature of the project was placed in effect. The meeting voted down the lease proposition that was submitted by Mr. Burges. The government has taken steps to install a temporary electric power plant at the site of the dam at Elephant Butte, at a cost of about $500,000. O. H. Ensign, chief electrical engineer of the reclamation service, is in charge of this branch of the dam project. D.

LIGHTING AND POWER.

(Special Correspondence.)

BARABOO, WIS.—Bonds for $45,000 for a lighting plant have been voted. C.

MILTON, N. D.—Christ Halley is promoting the installation of an electric light plant. C.

CUSTER, S. D.—A local stock company has been organized to install an electric light system. C.

SCOTTSBURG, NEB.—Mr. Roberts has commenced the installation of the electric light plant. C.

LONGVIEW, TEX.—This city is about to vote bonds for the extension of its electric light system. P.

HURON, S. D.—The Waage Electric Company has been incorporated with a capital stock of $25,000. P.

VELVA, N. D.—The council has granted a franchise to John I. Moore to install an electric lighting system. C.

ALVIN, TEX.—The Alvin Ice, Light & Power Company has been incorporated with a capital stock of $15,000. P.

DICKINSON, N. D.—Hughes & Deiters are planning extensive and permanent improvements to the lighting system. C.

GRANBURY, TEX.—The Granbury Water, Light, Ice & Power Company has been incorporated by R. Vickery and others. P.

EAGLE ROCK, CAL.—The Eagle Rock Water Company has been granted a franchise for installing an electric lighting system here. A.

DULUTH, MINN.—The city engineer has been instructed to prepare an estimate of the cost of installing a municipal light plant. C.

NEWTON, MISS.—The $11,000 bond issue which was voted for on March 6, for the purpose of installing an electric light plant, has been sold, and work will be begun in the near future putting in the plant.

MILWAUKEE, WIS.—The Globe Electric Company has been incorporated with a capital stock of $200,000 by G. W. Youngs and others. P.

LACROSSE, WIS.—M. W. Fockler, of Winona, will erect a power house to supply light and power to Endicott, Winona and Lacrosse. C.

KENDALLVILLE, IND.—This place will in a short time install a boulevard lighting system similar to those at South Bend and Mishawaka.

MARINETTE, WIS.—The cities of Marinette and Menominee propose to develop municipally a plant of 50,000 horsepower on the Menominee River. C.

BRAWLEY, CAL.—Superintendent McCormick, of the Holton Power Company, has applied for a franchise to supply electricity in this town for two years. A.

OAKLAND, CAL.—The American Heat & Power Company has been incorporated here by J. H. King, J. A. Craig and J. H. Becker with a capital stock of $100,000. A.

MOBRIDGE, S. D.—A franchise has been granted to the Mobridge Electric Light & Power Company to install an electric light plant and work will be started at once. C.

REDLANDS, CAL.—The Cochella Valley Ice & Electric Company has been incorporated by W. F. Holt, Chole Holt and W. G. Driver with a capital stock of $300,000. A.

DECORAH, IOWA.—Chicago capitalists are planning the construction of a dam to develop 600 horsepower to furnish electric power to Wauken, Pottsville, Lansing and other towns. C.

BONAPARTE, IOWA.—A franchise has been granted for the installation of an electric light plant. Power will be furnished from the dynamos in the United Woolen Mill power house. C.

DARBY, PA.—The Delaware County Electric Company has been awarded a five-year contract for lighting the borough streets with tungsten lamps. Fifteen 2,000-candlepower arc lamps are also to be installed.

KANSAS CITY, KAN.—This city will begin at once the construction of a municipal lighting plant to reduce the cost of electric lights. The issue of $350,000 of bonds for the municipal plant was authorized February 14.

SPRINGFIELD, O.—The International Harvester Company has authorized the erection of a power plant which will be built this spring. The new power station will be 80 by 150 feet in size and will be of brick and steel construction.

NOBLESVILLE, IND.—It is reported that the power dam and hydroelectric plant on White River belonging to the White River Light & Power Company will soon be ordered sold to discharge debts. The property represents an investment of $100,000. S.

MACDOEL, CAL.—The California Butte Valley Land Company has contracted with the Siskiyou Lighting Company to bring electricity into this town for lighting purposes, including the furnishing of 8,000 horsepower to farmers. The power is to be ready for use by July 1. A.

EUREKA SPRINGS, ARK.—The Eureka Springs electric system and entire holdings have been sold to a company consisting of E. F. Ackerman, of Chicago, and Hugo Seidel, of this city, and others. The deal embraces light and power plant, street railway, ice and cold storage and other interests.

WORCESTER, MASS.—A contract has been closed between the Worcester Pressed Steel Company and the Connecticut River Transmission Company, for the latter company to furnish 600 horsepower of electrical energy to the Pressed Steel Company, at its plant near Barbers Crossing. The Morgan Spring Company has also contracted for power from the transmission company.

CHARLOTTE, N. C.—A transaction involving $1,000,000 has been closed whereby fifty-one per cent of the stock of the street railroad, electric light and power and gas companies of Salisbury, Spencer and Concord, N. C., is transferred to William J. Oliver, of Knoxville, Tenn. The purchase also includes the franchise for the interurban electric line of twenty-two miles connecting Salisbury and Spencer.

HARRISBURG, PA.—Charters for twenty-eight electric companies to operate in Northampton, Lehigh and Carbon counties have been approved by the governor. Each of the companies has a capital of $5,000 and the same incorporators—W. A. Lathrop, Dorranceton; R. H. Wolbur, St. Davids, and H. F. Baker, Germantown, Philadelphia. The companies are understood to be incorporated by men interested in the Lehigh Coal and Navigation Company.

PORTLAND, ORE.—The sale of the power plant of the Monarch Lumber Company to the Mount Hood Railway & Power Company has been completed. The Monarch property will be used in connection with the new power plant of the Mount Hood Company, now in course of construction on the Peninsula, to provide energy to the light and power patrons in Portland and vicinity until the new hydraulic generating station at the junction of the Bull Run and Sandy Rivers is completed.

ELECTRIC RAILWAYS.

(Special Correspondence.)

ALGONA, IOWA.—The Iowa & Minnesota Construction Company is planning the construction of a line to Fairmont, Minn., via Armstrong. C.

SHEBOYGAN, WIS.—W. A. Comstock, president of the Milwaukee Northern Electric Road, announces that his company will commence grading next fall for an extension of the road to West Bend. C.

CLARKSBURG, W. VA.—The Tyler Traction Company has been chartered to build a line from Sisterville, Tyler County, through Middlebourn to the village of Shirley, also in Tyler County. The authorized capital is $500,000.

OMAHA, NEB.—The Nebraska & Transportation Company let the contract to the Baker Construction Company, of Omaha, for the construction of 284 miles of interurban line to Sioux City, with branches to Madison and Norfolk, Decatur and West Point.

PRIEST RIVER, IDAHO.—The Panhandle Electric Railway Company, headed by Victor M. Smith, of New York, plans to expend $2,000,000 in the construction of a power plant here, capable of developing 30,000 horsepower. The company also plans to build a transmission line to Spokane, Wash., seventy miles from this city. A.

REDONDO BEACH, CAL.—It has been ordered that a third rail be laid along the Los Angeles and Redondo right-of-way over portions of Pacific Avenue and Dimond Street. The order calls for immediate compliance. It is understood that when the work is completed passenger cars over the Los Angeles-Pacific system will be transferred from the Sherman barns to this city. A.

HIBBING, MINN.—A survey has been made for the construction of an electric line to Gilbert. The line will be thirty-six miles long and pass through Chisholm, Buhl, Virginia and Eveleth. The Washburn, Bailey & Mitchell Company, attorneys, represent the Boston capitalists interested. The Northern Traction Company has applied to the council for a franchise to construct an electric line. C.

VINCENNES, IND.—Articles of incorporation have been filed with the Secretary of State by the Vincennes Southeastern Indiana Interurban Railway Company. The initial capital stock is $50,000. The declared object of the new company is to build and operate an interurban railroad from Vincennes in Knox County to Jasper in Dubois County. George B. Hazleton, R. Q. M. Lewis and Ray Eubank are directors. S.

INDIANAPOLIS, IND.—By order of court, the Indianapolis, New Castle and Toledo Railway's property will be sold to pay claims amounting to $3,500,000. The Knickerbocker Trust Company of New York and the Union Trust Company of Indianapolis are the largest claimants. The company's property consists of an interurban road between Indianapolis and New Castle, power house, etc. The property will be sold as a unit within a short time. S.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

NEWTON, IOWA.—The Murphy Telephone Association has been granted a franchise. C.

EMMETSBURG, IOWA.—The Emmetsburg Telephone Company will expend $6,000 in improving its system. C.

KINGFISHER, OKLA.—The Wandell Telephone Company has been incorporated by J. L. Faxon and others. P.

WEBSTER CITY, IOWA.—E. H. Martin secured a site for the erection of a fireproof and cement telephone exchange. C.

FREDERICK, S. D.—The Franklin & Frederick Telephone Company has been incorporated with a capital stock of $24,970. P.

JAMESTOWN, N. D.—W. J. Ries, Andrew Michael and others have organized a company to construct a telephone line to Beaver Creek. C.

SUSANVILLE, CAL.—The California & Oregon Telegraph Company has applied for a fifty-year franchise for a telephone system in this town. A.

WILLIAMS, CAL.—Amiel M. Harris has purchased the telephone lines in this city and is having them looked over, extended and improved. A.

LA CROSSE, WIS.—The La Crosse Telephone Company has secured a site for the erection of a modern telephone building, estimated to cost $15,000. C.

BUFFALO, N. Y.—The Greissinger Telephone Repeater Company was recently incorporated to manufacture telephone repeaters, etc. The directors of the concern are Elwood Greissinger, Lucy A. Greissinger and Chilian F. Wheeler, all of Buffalo.

GUERNSEY, UTAH.—The Guernsey Telephone Company and the Platte Valley Telephone Company recently were consolidated under the management of Walter L. Diver. The new arrangement gives all of the Guernsey Telephone Company subscribers long distance service over the Bell lines, this company being now in effect a sub-licensee of the Rocky Mountain Bell Telephone Company as well as the Platte Valley Company.

ELECTRICAL SECURITIES.

Business on the stock exchange still continues to be exceedingly dull, but finance on the whole is on a very sound basis at present, and investors are merely waiting for a decision of the Standard Oil and American Tobacco cases. More business was done in bonds during the four working days of the week, however, than in the same part of the previous week.

Bedell & Company, of Providence, announce that they have sold all of the $1,000,000 Illinois Traction Company preferred stock recently offered.

The Reading Transit Company has filed notice of an authorization of a bond issue of $20,000,000.

There has been placed on the unlisted department of the Philadelphia stock exchange $116,250 additional Philadelphia Rapid Transit Company voting trust certificates.

American Telephone stockholders have crossed the 40,000 mark. This is not only the largest number in the company's history, but the third largest body of shareholders of any American corporation. In this respect American Telephone is surpassed only by United States Steel and the Pennsylvania Railroad. With $263,000,000 capital stock and 40,000 shareholders, American Telephone has as many stockholders as Union and Southern Pacific combined with their $489,000,000 of share capital. When President Vail came to American Telephone there were but 18,000 shareholders and the popular cry was that an increase in the list of owners of the property to 25,000 would lift the burden of financing. In the four years of the present administration there has been a gain of 22,000, or 21 per cent, in number of shareholders, a yearly average gain of over thirty per cent.

DIVIDENDS.

American District Telegraph Company of New Jersey; regular quarterly dividend of one per cent payable April 28 to stock of record April 18.

Binghamton Light, Heat & Power Company; regular quarterly dividends of one and one-half per cent on the preferred stock and three-quarters of one per cent on the common stock, payable April 15 to stock of record March 31.

Electric Bond & Share Company; quarterly dividends of one and one-quarter per cent on the preferred and two per cent on the common stock. The preferred dividend is payable May 1 to stock of record April 30. The common dividend is payable April 15 to stock of record April 13.

Havana Electric Railway Company; regular quarterly dividends of one and one-half per cent on the preferred and one and one-half per cent on the common stocks, payable May 13 to stock of record April 22.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Apr. 17.	Apr. 10.
Allis-Chalmers common	7½	7½
Allis-Chalmers preferred	29	30
Amalgamated Copper	62⅜	62½
American Tel. & Cable	*80	80
American Tel. & Tel.	145½	145⅞
Brooklyn Rapid Transit	77¾	77¾
General Electric	150⅛	150⅜
Interborough-Metropolitan common	18½	18¾
Interborough-Metropolitan preferred	52¾	54
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	90½	90½
Mackay Companies (Postal Telegraph and Cables) preferred	76¼	76¼
Manhattan Elevated	136	136
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	50½	51
U. S. Steel common	77	77⅝
U. S. Steel preferred	119½	119
Western Union	72⅝	73¼
Westinghouse common	65½	65½
Westinghouse preferred	117	117½

*Last price quoted.

BOSTON.

	Apr. 17.	Apr. 10.
American Tel. & Tel.	145½	145¾
Edison Elec. Illuminating	283	283
General Electric	150⅛	150¼
Massachusetts Electric common	16¾	17
Massachusetts Electric preferred	87½	87½
New England Telephone	142	141
Western Tel. & Tel. common	19	19
Western Tel. & Tel. preferred	93½	93¾

PHILADELPHIA.

	Apr. 17.	Apr. 10.
American Railways	44¾	43¾
Electric Company of America	11¾	12
Electric Storage Battery common	52½	53
Electric Storage Battery preferred	52½	53
Philadelphia Electric	16¼	16¼
Philadelphia Rapid Transit	18¼	18⅜
Philadelphia Traction	84	84
Union Traction	46½	46

CHICAGO.

	Apr. 17.	Apr. 10.
Chicago Railways, Series 1	83	83
Chicago Railways, Series 2	23	23
Chicago Subway	4½	4⅝
Chicago Telephone	118½	119
Commonwealth Edison	128	128
Metropolitan Elevated common	22	22
Metropolitan Elevated preferred	68	67

PERSONAL MENTION.

BUTLER KEYS, sales manager of the Hemming Manufacturing Company, of Garfield, N. J., has just returned from a successful trip through the West. He reports business very good.

HORACE G. BURT has been chosen by the Chicago Association of Commerce as chief engineer to take charge of the Chicago electrification problem. He will assume his new duties May 1.

E. W. OLDS, for seventeen years superintendent of the rolling stock of The Milwaukee Electric Railway & Light Company has resigned, and will go to California to engage in the real estate business.

WILLIAM J. NORTON, first assistant secretary to the Public Service Commission of the First District of New York, has resigned his position to accept one with the Commonwealth Edison Company, of Chicago.

LEONARD J. BOTTING has resigned his position as secretary and general manager of the Central Station Development Company of Cleveland, O., in order that he may more effectively do special work for the company.

MILES BRONSON, heretofore division superintendent of the New York Central at Albany, N. Y., has been appointed superintendent of the electric division, succeeding C. L. Bardo, who has gone to the Lehigh Valley.

H. M. SLAUSON has severed his connection with the Opalux Company as its general sales manager and from May 1 will represent the H. W. Johns-Manville Company, handling its electrical business in the state of New Jersey.

ANGUS S. HIBBARD, general manager of the Chicago Telephone Company, has been made a member of the staff of the American Telegraph & Telephone Company. Mr. Hibbard's numerous friends in Chicago hope that he will not find it necessary to take up his residence in New York.

THEODORE N. VAIL, president of the American Telephone & Telegraph Company, and president of the Western Union Telegraph Company, accompanied by Mrs. Vail, recently sailed on the steamer *Cedric* for a four months' tour of France and Spain. Mr. Vail said he was making the trip to obtain rest.

ALONZO BURT, president of the Milwaukee Telephone Company, will, on May 1, become vice-president and treasurer of a group of telephone properties which include the Wisconsin Telephone Company. Mr. Burt will for the present remain in Milwaukee, although ultimately he will remove to Chicago.

BION J. ARNOLD, of Chicago, has been chosen as engineer to the Committee on Downtown Model Streets. Mr. Arnold is peculiarly fitted for this post because of his long study of the questions involved in the committee's investigations, and because of his accumulated material which will be necessary in the committee's study.

EDWARD C. SWEENEY, superintendent of the French Telegraph Cable Company, has been appointed traffic manager of this company and general manager of the United States & Hayti Telegraph & Cable Company, to succeed the late Louis A. Lurienne. Mr. Sweeney has been thirty-two years in the French Telegraph Cable Company's service.

RODMAN GILDER, secretary of the Crocker-Wheeler Company, manufacturers of electrical machinery, Ampere, N. J., has resigned to become associated with the brokerage house of Dick Brothers & Company, 30 Broad Street, New York. His previous experience should be of value to him in the analysis of bonds of industrial and other corporations.

CLARENCE E. FREEMAN, who for several years has been one of the engineering staff of the Arnold Company, Chicago, has associated himself with the W. H. Rosecrans Engineering Company, Stock Exchange Building, Chicago, as treasurer and consulting engineer. Mr. Freeman was for many years professor of electrical engineering at Armour Institute of Technology, where he endeared himself to his students by the thoroughness and breadth of his educational work. Illness compelled him to leave this position in 1906. Soon afterwards he joined the Arnold Company and subsequently took charge of its irrigation, drainage and hydroelectric work in the West. Mr. Freeman will continue to specialize in this field with the company that he has become interested in.

CONVERSE D. MARSH, president of the Bates Advertising Company, New York City, was knocked down in Fifth Avenue near Fifty-sixth Street, in that city, last Sunday afternoon, by an automobile owned by J. W. Earle, president of the Union Typewriter Company. He was removed to Flower Hospital suffering from a fracture of the right leg. His daughter, Miss Faith Marsh, was with him at the time. They had stepped from the curb on the east side of the thoroughfare and were attempting to get across the street between the automobiles. The Earle machine, which was going north on the avenue, was seen by Miss Marsh, who jumped back and tried in vain to drag her father out of its path. At the hospital Mr. Marsh is reported doing nicely. The small bone of the leg was broken just above the ankle. Mr. Marsh is very widely known in the electrical field, and established the Bryan-Marsh Lamp Company before entering his present field of work.

H. P. BROUGHTON, who for several years has devoted his energies to the development of the hydroelectric system of the Southern Wisconsin Power Company, of which he has been general manager, has resigned his position to become the manager of the contract department of the Georgia Power Company. He will have his headquarters in Atlanta, Ga., where he will direct the building of a power load, so that when the 60,000-horsepower plant of the company at Tallulah Falls will be completed, in the summer of 1912, it will find ready a heavy power demand. Mr. Broughton brings to his new position an extended experience both as an engineer and executive. After graduating as an M. E. from Cornell University in 1890, he became assistant to the general manager of the old Municipal Electric Light & Power Company of St. Louis, Mo., opening subsequently an office in St. Louis as consulting and contracting electrical engineer. He then took up his work in Chicago and soon afterwards became associated with the Fort Wayne Electric Works, Fort Wayne, Ind. We next find him in the first vice-president's office of the General Electric Company at New York City. In 1905 Mr. Broughton joined the Great Northern Power Company, of Duluth, Minn., and three years later became the general manager of the Southern Wisconsin Power Company, at Madison and Kilbourn, Wis.

OBITUARY.

EUGENE W. SULLIVAN, secretary of the Cosmopolitan Electric Company, died in Chicago, April 14, after a long illness of rheumatism of the heart. Mr. Sullivan was interested in a number of industrial companies and was also prominent in politics.

HENRY F. DIMOCK, president of the McCall Ferry Power Company, and prominent in finance and railroad circles, died April 10 at his home in New York City. Mr. Dimock has been ill for a number of weeks, having been attacked by paralysis and heart disease.

NEW PUBLICATIONS.

MINERAL OUTPUT FOR 1909.—The annual chart issued by the United States Geological Survey to show the value of the mineral production gives a figure of $1,885,925,187 for the year of 1909. Of the ten leading minerals coal heads the list, with a value of $554,902,624, which is more than the total mineral production in 1893 or 1894; iron is second, with $419,175,000; clay products third, $166,321,213; copper fourth, $142,083,711; petroleum fifth, $128,248,783; gold sixth, $99,673,400; stone seventh, $71,345,199; natural gas eighth, $63,206,941; cement ninth, $52,797,973; and lead tenth, $24,864,300.

UNIVERSAL ELECTRICAL DIRECTORY.—The 1911 edition of the Universal Electrical Directory has come to hand and contains as usual a most valuable list of electrical firms and electrical engineers in the United Kindom and Colonies, Continental Europe and the United States, the total number of names amounting to 33,900. A new feature of this edition is the separation of London names in the British alphabetial section under separate headings. A list of central power stations is given for the United Kingdom, British Colonies and the United States. As usual each section of the volume is subdivided under alphabetical and classified headings. The directory is published by H. Alabaster, Gatehouse & Co., 4 Ludgate Hill, London, England.

NEW INCORPORATIONS.

CLEVELAND, O.—The Illuminating Supply Company, electrical engineers and supply dealers, has been incorporated with a capital of $10,000 by Arthur Reynal Flint, Jessie R. Schoenberger, P. F. McConnell and Harry E. Davis.

TOLEDO, O.—The Mill Anthony Company of Toledo has incorporated with a capital of $10,000 to deal in electric specialties. The incorporators are Benjamin Mills, Dan W. Miller, J. V. Kieler, George E. Anthony and J. J. Waldvogel.

CINCINNATI, O.—The Electric Heater Company has been incorporated with a capital stock of $50,000 to manufacture electric devices. The incorporators are David M. Levy, Ben H. Lomax, S. C. Roettinger, A. N. Harvie and Harry B. Street.

ALLIANCE, O.—The Electric Furnace Company has been incorporated with a capital of $20,000 for the purpose of manufacturing electric furnaces to be used in the treating of metal. The incorporators are T. F. Bailey, H. F. Bohecker, F. L. Mowry, William H. Miller and H. B. Webber.

PROPOSALS.

POST OFFICE, COFFEYVILLE, KANS.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until May 18 for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States post office at Coffeyville, Kans., in accordance with the drawings and specification, copies of which may be obtained from the Custodian of site at Coffeyville, or at the Supervising Architect's office.

POST OFFICE, WARRENSBURG, MO.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until May 22 for the construction, complete (including plumbing, gas-piping, heating apparatus, electric conduits and wiring), of the United States post office at Warrensburg, Mo., in accordance with the drawings and specification, copies of which may be obtained from the custodian of site at Warrensburg, or at the Supervising Architect's office.

INDUSTRIAL ITEMS.

THE MINNEAPOLIS STEEL & MACHINERY COMPANY, Minneapolis, Minn., includes in its April stock list a varied line of electrical machinery as well as engines, pumps, etc.

THE CARLISLE & FINCH COMPANY, Cincinnati, Ohio, is sending out catalogs of working models of electric railway apparatus. The line of toy tracks and locomotives which is illustrated is exceptionally complete and unique.

THE AMERICAN CIRCULAR LOOM CO., Boston, Mass., has mailed folders advertising "Lutz" metal molding. This molding is a continuous galvanized steel raceway in which the wires are laid instead of being drawn through.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., announces by means of a novel folder, that on April 15 its Chicago offices were moved into the Peoples' Gas Building at No. 122 South Michigan Boulevard.

THE FLEXLUME SIGN COMPANY, Buffalo, N. Y., has reproduced a number of letters testifying to the satisfaction which its Flexlume day-night signs are giving customers. A number of installations are illustrated in connection with these testimonials.

THE IDEAL ELECTRIC & MANUFACTURING COMPANY, Mansfield, O., describes its squirrel-cage polyphase induction motors in bulletin No. 1041. In addition to a number of illustrations several curves are given, showing the performance of induction motors of various sizes.

THE REYNOLDS ELECTRIC FLASHER COMPANY, Chicago, Ill., recently issued a bulletin and price list on type "L" Reco flashers for electric signs and flashers of all descriptions. The company announces that it will remove on May 1 to 617-631 West Jackson Boulevard.

THE PACIFIC ELECTRIC HEATING COMPANY, Ontario, Cal., has included a double page illustration of its factory at Ontario in the current issue of *Hot Points*. Some of the pages of one of the 1911 folders are reproduced, these folders being furnished free of charge to the company's customers.

W. N. MATTHEWS & BROTHER, St. Louis, Mo., have distributed the third edition of the Matthews Telephone Line Construction Book. This loose-leaf bulletin treats thoroughly the methods of both overhead and underground cable construction showing sections of conduit and giving numerous tables on construction cost, etc.

B. F. STURTEVANT COMPANY, Hyde Park, Mass., has reprinted an article on "Economical Fire-Room Methods" which was first published in *Power and the Engineer*. George H. Diman, in connection with whom F. R. Low, prepared the article, gives a great deal of interesting information covering a long period of practical experience.

THE CENTURY ELECTRIC COMPANY, Chicago, Ill., directs the attention of power users to the Century single-phase motor through an advertisement appearing on the front page of the current issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN. These motors are especially designed for use under severe operating conditions.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, O., describes direct-current generators of the engine type in bulletin No. 461. These generators are built in capacities from thirty to 1,000 kilowatts. The smaller sizes from four up to twenty-five kilowatts, which are known as the Marine type, are described in a separate publication.

THE GENERAL VEHICLE COMPANY, Long Island City, N. Y., includes in the current issue of *Elec-Tricks* an article on G. V. Electrics in United States Postal Service and also a reprint of an item on New York's Motor Mail Wagons which appeared in the *New York Tribune*. Several illustrations showing the various uses of the heavier type of electric trucks are included.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., describes and illustrates its small direct-current generating sets in Bulletin No. 130, which was recently mailed. These machines, direct connected to a vertical engine, are especially designed for isolated lighting plants and also provide a convenient source of power for driving small machines such as vacuum cleaners, dumb waiters, etc.

THE GREGORY ELECTRIC COMPANY, Chicago, Ill., announces that it provided the generating machinery for a municipal plant operating in the town of Boley, Okla. The town of Boley has the distinction of being exclusively a town of colored people and the lighting plant is said to be the only one in the United States owned and operated by negroes and selling power to a negro community.

THE MORRIS IRON COMPANY, New York, N. Y., has been awarded a contract with the City of Richmond, Virginia, for furnishing 200 arc lamp brackets to be used in connection with the wooden poles carrying transmission lines. The five-light ornamental tungsten clusters used on the main streets of that city were furnished by the Frederick Iron Works, which has been succeeded by the Morris Iron Company.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has published in the April number of *The Emerson Monthly* a number of half-tone engravings of various sizes of motors and fans, the original cuts of which will be furnished to the trade free of charge. Two attractive two-column pamphlets have been prepared for the season of 1911 and these will be furnished to dealers with their names printed thereon.

SPRAGUE ELECTRIC COMPANY, New York, N. Y., has compiled a very attractive catalog on the Sprague electric fan. The Lundell type of electric fans, which are manufactured by this company, were the first successful electric fans to be placed on the market, and this type after many years still maintains its high grade of excellence. A number of exhaust fan-motors, ceiling fans, desk fans and bracket fans are illustrated.

THE SANGAMO ELECTRIC COMPANY, Springfield, Ill., is distributing a twenty-four-page technical bulletin describing the construction, principle of operation and application of the improved type "H" induction watt-hour meter. The bulletin is profusely illustrated. The illustrations, showing a radically new type of magnetic circuit, will be of particular interest to electrical engineers interested in alternating-current measurements.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., recently mailed bulletin No. 1079 describing its steam-turbine units. This bulletin contains a description of the Allis-Chalmers type of machine, together with numerous illustrations showing both details of construction and complete installations. It will be observed that practically every class of industry is represented. Bulletin No. 1624, covering the standard line of centrifugal pumps, has also been distributed.

E. W. BLISS COMPANY, Brooklyn, N. Y., has distributed part 12-A of the catalog of machinery for manufacturing electrical parts. The company makes a specialty of presses for stamping out armature discs, telephone stampings, lamp sockets, reflectors, call boxes and, in fact, any of the stamped metal material used in the electrical trade. The standard presses and stamps which are manufactured are illustrated in the catalog and announcement is made that special types will be made according to the purchaser's specifications.

McMEEN & MILLER, Chicago, Ill., announce that Samuel G. McMeen is returning to Chicago to engage in the general engineering work in which the firm is engaged. Mr. McMeen has for the past four years been engaged upon a specific design, construction and development of independent telephone properties in San Francisco and neighboring California cities, a work which required all his time and energies. His availability for general practice will greatly increase the capacity of the firm for handling the work and problems of its clients.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has received an order from the Riverside & Dan River Cotton Mills, Danville, Va., for one 200-kilowatt, 600-volt, three-phase generator, one 351-kilowatt, 600-volt, three-phase generator, two twenty-kilowatt, 125-volt exciters, three forty-kilovolt-ampere transformers, sixteen induction motors of ten to 100-horsepower capacity, and a 600-volt alternating-current switchboard. The latter consists of one double-circuit exciter panel, one single-circuit lighting feeder panel, and one double-circuit feeder panel for furnishing power to induction motor throughout the factory.

PYRENE MANUFACTURING COMPANY, 412 East Thirty-second Street, New York, N. Y., is putting upon the market its liquid fire extinguisher, known as "pyrene." When heated to 200 degrees this liquid is vaporized and by surrounding the fire excludes oxygen and extinguishes the flame. It is a non-conductor, does not corrode metals or injure varnish or fabrics, will not freeze or deteriorate. The extinguisher is a tube three inches in diameter by fourteen inches long and weighs about five pounds. It has been approved by the fire underwriters, and is in use by many lighting companies, trolley lines, public schools and fire departments.

THE INTERNATIONAL ACHESON GRAPHITE COMPANY, Niagara Falls, N. Y., recently mailed an attractive bulletin on its factory facilities and numerous products. The publication mentions many of the results of the use of electric power in manufacturing and the special products needed to meet the requirements of the electrolytic and electrothermic field. A large number of illustrations show the graphite in various forms as it appears in the factory and give some idea of the enormous output of the plant. Acheson-Graphite is all made in electric furnaces, all other kinds being taken from the earth. Of this manufactured graphite the company placed on the market more than 13,000,000 pounds during the past year.

THE FOUNDRY & MACHINE EXHIBITION COMPANY, Pittsburg, Pa., has issued a prospectus of the sixth annual exhibit which will be held in the large buildings of the Western Pennsylvania Exhibition Society, Duquesne Way, Pittsburg, at the time of the conventions of the American Foundrymen's Association, the American Brass Foundrymen's Association and the American Foundry Foremen's Association. The exhibition will include foundry and machine-shop tools and equipment, pattern-shop machinery, and all kinds of supplies and appliances used in manufacturing industries. It will be open from May 23 to June 1, and applications for space should be made at once. The prospectus contains many interesting

views of the exhibits taken at the Detroit Exhibition in 1910. The secretary of the Exhibition Company is C. E. Hoyt, Lewis Institute, Chicago, Ill.

THE HOOPER-FALKENAU ENGINEERING COMPANY has recently been formed to take over the business of George K. Hooper, designer and organizer of industrial plants. Mr. Hooper's experience covers a period of twenty-five years of work ranging in importance from that of an unskilled laborer to executive and consulting engineer. His recent work has included the designing and planning of a wide variety of industrial projects. The design of new machinery for special purposes as well as the management of plants, are among Mr. Hooper's activities. One of his most notable connections in the latter capacity has been the management of the Weir Frog Company, Cincinnati, O., with which he has been connected for five years and at present is serving as vice-president and general manager. Mr. Falkenau, in joining forces with Mr. Hooper, withdraws from the Falkenau-Sinclair Machine Company of Philadelphia, of which he has been president for a number of years. His best known work is in the field of designing and manufacturing special machinery. In the course of thirty years' experience as a consulting engineer and owner of machine works, Mr. Falkenau has designed and perfected many successful devices, among which probably the best known is the pneumatic system for handling mail. The new firm will carry on the same class of work that each member has done previously.

DATES AHEAD.

Nebraska Electrical Association. Annual convention, Lindell Hotel, Lincoln, Neb., April 24-26.

Electrical Supply Jobbers' Association. Annual convention, Del Monte, Cal., April 25, 26 and 27.

American Institute of Electrical Engineers. Pacific Coast meeting, Los Angeles, Cal., April 25-28.

Southwestern Electrical and Gas Association. Annual convention, Houston, Tex., April 27-29.

Arkansas Association of Public Utility Operators. Annual convention, Little Rock, Ark., May 3, 4 and 5.

American Foundrymen's Association, American Brass Founders' Association and the Associated Foundry Foremen. Annual Convention, Pittsburg, Pa., May 23-26.

National Electric Light Association. Annual convention, New York City, May 29 to June 3.

Commercial Section, National Electric Light Association. Meeting and banquet, New York, N. Y., June 1.

Association of Railway Electrical Engineers. Semi-annual convention, Washington Terminal Station, Washington, D. C., June 16 and 17.

Association of Railway Telegraph Superintendents. Annual meeting, Boston, Mass., June 19-23.

Mississippi Electric Association. Annual convention, Gulfport, Miss., June 20-21.

American Institute of Chemical Engineers. Semi-annual meeting, Chicago, Ill., June 21 to 24.

Society for the Promotion of Engineering Education. Annual meeting, Pittsburg, Pa., June 26, 27 and 28.

Association of Railway Electrical Engineers. La Salle Hotel, Chicago, November 6-10.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) April 11, 1911.

988,986. ELECTROMECHANICAL STOPPING MECHANISM FOR LOOMS. John F. Dustin, Fulton, N. Y. Filed June 20, 1910. Failure of a warp thread releases a heddle and closes a controlling circuit for releasing a shipper and stopping the loom.

989,008. CIRCUIT TROUBLE-INDICATOR. Clarence L. Healy, Chatham, N. J., assignor to New York Quotation Co. Filed Oct. 12, 1910. A printing-telegraph circuit indicator comprises two normally balanced co-operating partial circuits, printing instruments having operative parts in circuit respectively with each of the partial circuits, and an electrically operated device coacting with these circuits for indicating a lack of balance in them.

989,013. LAMP-GUARD. Harvey Hubbell, Bridgeport, Conn. Filed Aug. 11, 1910. A wire guard for incandescent lamps has two parallel rings for grasping the lamp socket above and below its rib and means for clamping it in place.

989,018. ALTERNATING-CURRENT MAGNET. Nils O. Lindstrom, Nutley, N. J., assignor to Alonzo B. See, New York, N. Y. Filed Oct. 27, 1910. Both the magnet and its armature have pole pieces of laminated iron with tongues projecting into the interior of the energizing coil.

989,030. GOVERNOR FOR GAS-ENGINES. Perry Okey, Columbus, Ohio, assignor of one-half to Sarah Louis Okey, Columbus, Ohio. Filed Feb. 16, 1910. The engine is direct-connected to a dynamo. Two electrically controlled valves govern the supply of fuel to the engine, one having its coil in series with the dynamo and therefore changing its opening with variations of the load, the other having its coil in parallel with the dynamo so as to close its valve on excess voltage and open it when the voltage is too low.

989,052. APPARATUS FOR OPERATING ALARMS AND OTHER DEVICES. George I. Rockwood, Worcester, Mass. Filed Dec. 3, 1909. A diaphragm in a pressure chamber is operated by excess water pressure so as to shut a valve and close an alarm circuit.

989,057. STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES. Welton H. Rozier and Samuel C. Igou, St. Louis, Mo., assignors to Motor Car & Device Co., St. Louis, Mo. Filed July 10, 1908. An ignition magneto is arranged to have its armature revolved by means of a pedal-actuated rack which engages a gear on its shaft and thus produces an initial spark.

989,063. SYSTEM OF MOTOR CONTROL. George B. Schley, Milwaukee, Wis., assignor to Allis-Chalmers Co. Filed July 8, 1909. Comprises a generator with separately excited field circuit in which are a number of automatic switches, a reversible motor with its armature connected to that of the generator through a device that prevents any variation of the field-circuit resistance that would result in excess motor current.

989,065. APPARATUS FOR HANDLING MAGNETIC MATERIALS. James F. Schnabel, Cleveland, Ohio, assignor to Electric Controller & Manufacturing Co., Cleveland, Ohio. Filed March 31, 1910. Co-operating with a double bucket supported by pivotally arranged bars is lifting magnet which passes between the two sections of the bucket to pick up magnetic ore and when lifted over the edges of the bucket, the two parts of which have come together, drops its load into the bucket. This is repeated till the bucket is full.

989,107. FIRE-ALARM. Julius Eugene Barrett, Pollock, La., assignor to J. W. Wilson, C. U. Robinson, George A. Foster and F. O. Maxwell, Pollock, La., and John R. Hunter and Eugene Nolan, Alexandria, La. Filed April 30, 1910. The armature of two separate electromagnets is arranged between them. A fusible connection in the circuit of the stronger releases the armature so that the other magnet actuates it to strike an alarm bell.

989,112. TROLLEY-POLE. Charles E. Bradford, Lakeview, Wash. Filed Sept. 19, 1910. Has tubular alining members disposed to end, in combination with a spindle connecting the members and to which they are swivelly connected.

989,132. ANNUNCIATOR FOR EXPLOSIVE-ENGINES. Rodney C. Dewey, Hoytville, Ohio. Filed April 1, 1908. An engine with a number of explosive chambers has an electric lamp for each chamber, and means controlled by the explosions in the respective chambers for lighting their respective lamps.

989,133. SELECTOR MECHANISM. Amos F. Dixon, New York, N. Y., assignor to Western Electric Co., Chicago, Ill. Filed Jan. 20, 1908. In combination with a movable switch member is a selecting member, selectively controlled electrical means for advancing it, and motor mechanism arranged to return the selecting member to its initial position and to drive the movable switch, a distance predetermined by the extent of movement of the selecting member.

989,134. ELECTROMAGNETIC COMPASS. Louis Dominique Joseph Armand Dunoyer, Versailles, France. Filed March 5, 1907. A coil capable of rotating in a magnetic field has two windings to each of which is connected a separate pair of half rings on which bear brushes in the circuit of two reflecting galvanometers whose deflected line reflections indicate at their intersection the position of the ship.

989,145. COMBINED FISHING-FLOAT AND FLASH-LIGHT. Andrew Hatchett, Louisville, Ky. Filed June 10, 1910. A fishing float having an electric lamp and a battery, and means operated by the fishing line for completing the circuit from the battery to the lamp.

989,148. CARBON-HOLDER FOR ELECTRIC FURNACES. Paul L. T. Heroult, La Praz, France, assignor to Societe Electro-Metallurgique, Francaise, Froges, France. Filed Sept. 7, 1910. Comprises a metallic clamp adapted to embrace the carbon, having a duct traversing it in circumferential direction through which to circulate a cooling fluid, and slitted both internally and externally.

989,169. ELECTROMETALLURGICAL FURNACE. Francois Louvrier, Mexico, Mexico. Filed Dec. 18, 1909. Has a condensing chamber built up within the furnace body in such manner as to divide the interior into two separate and distinct reduction chambers, and provided with openings through the upper parts of its walls to allow inflow of volatilized metals from the reduction chambers.

989,191. MULTIPLE TELEPHONE-RECEIVER. William B. Relth, Chicago, Ill., assignor of nine-tenths to Henry G. Guyle, West Union, Neb. Filed Aug. 14, 1905. The cord attached to the receiver has spring clip terminals for connecting it conveniently to the circuit.

989,194. SIGNAL SYSTEM FOR RAILWAYS. Alfred L. Ruthven, Topeka, Kans., assignor to Ruthven Railway Signal Co., Phoenix, Ariz. Filed Feb. 20, 1909. The car carries a battery and trolley wheel for engaging occasional sections of a third rail between which and the main rails the signal-controlling circuit is connected.

989,205. TELEPHONE SYSTEM. David L. Temple, Chicago, Ill., and Charles L. Goodrum, Atlantic City, N. J., assignors to Stromberg-Carlson Telephone Manufacturing Co. Rochester, N. Y. Filed March 1, 1902. Relates to means for lighting the line signal lamps, which is done through differential relays associated with the line circuits and jacks.

989,220. CHAIN-GUIDE FOR ELECTRICAL PULL-SOCKETS. David P. Wolhaupter, Washington, D. C. Filed Jan. 5, 1911. Comprises, in combination with the shell and cap of socket casing, a guide body consisting of separate sections held in register by the cap when fitted to the shell.

989,231. INSULATOR-SUPPORT. Wilbur L. Chamberlain, East Hartford, Conn. Filed June 5, 1908. A set of posts with angularly bent tops is arranged to carry inclined insulators so that each may be swung over the ends of the other posts.

989,250. TRANSMISSION OF SOUND. Delia M. Gray, Highland Park, Ill., executrix of Elisha Gray, deceased, assignor to Submarine Signal Co. Filed April 15, 1901. A system for the transmission of sound by water has in combination with a common receiver means for producing sound waves in water with a submerged multiple electric sound receiver and transmitter, comprising a group of independent transmitters adapted simultaneously to receive and continuously to transmit sound waves originating at the same source to the common receiver.

989,259. VAPOR ELECTRIC APPARATUS. Peter Cooper Hewitt, New York, N. Y., assignor to Cooper Hewitt Electric Co. Filed Feb. 20, 1902. Renewed April 11, 1904. A mercury-arc rectifier for polyphase currents has three anodes connected to the secondary terminals of a Y-connected transformer, the cathode being connected to the neutral point through an inductance.

989,273. THERMOSTATIC CONTROL FOR ELECTRIC HEATING DEVICES. Elmer C. McBride, Santa Ana, Cal. Filed July 26, 1909. An electric flatiron contains a thermostatic bar adapted to close or break the heating circuit.

989,276. SAFETY APPLIANCE FOR RAILWAY-TRACKS. Joseph Morton, Vancouver, British Columbia, Canada. Filed March 22, 1910. A pipe extending along the track connects a set of open vessels adapted to hold liquid at the same level. A float in each controls a switch in a semaphore circuit.

989,289. ELECTRIC-LIGHT FIXTURE. Jacob J. Raithel, St. Louis, Mo. Filed March 26, 1910. At the center of a chandelier is a pair of sections each provided with a clamping ring and adapted to clamp the lamp-supporting arms between them.

989,290. INDICATING-CLOCK. Willie W. Rhame, Summerville, and Samuel H. Nuckolls, Charleston, S. C.; said Nuckolls assignor to said Rhame. Filed April 25, 1910. An indicator comprises a clock, an endless carrier driven therby, indices connected with the carrier, means co-operating with the indices for imparting information visually, an electrically actuated sound-reproducing machine, and electric contacts controlled by the carrier for causing the actuation of this machine at predetermined times.

989,292. ELECTRIC-ARC LAMP. William R. Ridings, Stretford, England, assignor to Westinghouse Electric & Manufacturing Co. Filed Dec. 28, 1905. An inclined-carbon arc lamp has a shunt regulating coil and means for moving the electrodes together to strike the arc.

989,298. ELECTRIC METER. Gustave A. Scheeffer, Indianapolis, Ind., assignor to Columbia Meter Co., Indianapolis, Ind. Filed Jan. 14, 1910. Relates to the construction of a bent-bar bracket for supporting part of the meter mechanism.

989,305. ELECTRICAL SYSTEM OF DISTRIBUTION. William H. Sherbondy, Fort Wayne, Ind., assignor to Gould Coupler Co. Filed Nov. 3, 1910. A voltage regulator for a number of lighting circuits is disconnected when all the switches in these circuits are open and connected in when any of their switches is closed.

989,330. PHOTOGRAPHIC-PRINTING APPARATUS. Henry Burke and David James, Chicago, Ill. Filed Jan. 2, 1909. Inside the box are two electric lamps, one plain and the other ruby colored. The circuit of the letter is normally closed; the circuit of the former is separately closed.

989,335. SIGNAL FOR FIRE-SPRINKLER SYSTEMS AND THE LIKE. Leonard D. Chandler, North Abington, Mass. Filed March 4, 1910. An electric bell circuit is closed when more than a predetermined volume of water has passed.

989,347. ELECTRICAL THERMOSTAT. Albert Goldstein, New York, N. Y., assignor to International Electric Protection Co. Filed May 2, 1910. Within a casing is a diaphragm close to an electric contact for an alarm circuit which is closed when the air within expands unduly.

989,362. KNIFE-SWITCH. Orin H. Hoeft, Brownlee, Neb. Filed May 24, 1910. A switch has a plurality of blades mounted on two pivot posts, these posts being connected by a metallic strip.

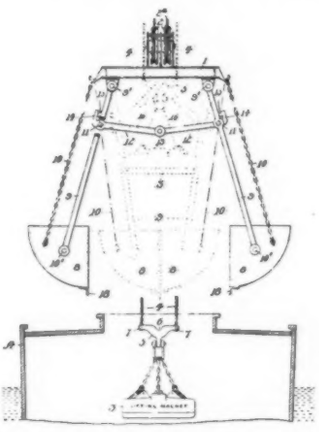
989,364. SWITCH. Claud Huffman, Versailles, Mo. Filed July 23, 1910. Terminal contacts, binding posts, etc., are mounted on a tubular insulating members. The switch blade, pivoted at the center, is provided with means for engaging it with either of the contacts.

989,394. OVERHEAD TROLLEY. Henry D. Murdock, Scottburg, Ind. Filed Dec. 29, 1909. A switch member mounted so as to connect the main trolley with the trolley of the branch line is operated when the track switch is thrown.

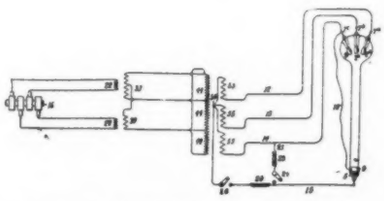
989,401. CONTROLLER FOR ELECTRIC MOTORS. William A. Paris, Edgewood Park, Pa., assignor to Westinghouse Electric & Manufacturing Co. Filed Dec. 28, 1905. A contact-bearing drum is operated in one direction by a float and in the other by an actuating spring so that the motor is started gradually when the water is lowered below a certain point. The controller works with a step-by-step movement.

989,414. ELECTRIC TANK-SWITCH. Harry A. Prindle, East Orange, N. J., assignor of one-half to Francis H. Stillman, Brooklyn, N. Y. Filed Oct. 14, 1908. Combines a movable circuit-closing device, a pivoted driver operative to move the device to and from its working position, the driver having on it a projection, a pulley, a float and counterweight and flexible tie secured together, the tie extending over the pulley, and a pair of devices attached to the tie and adapted to act on opposite sides of said projection.

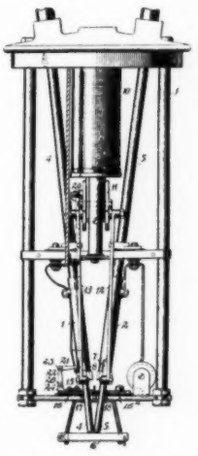
989,420. FIRE-ALARM. Louis Tasman Reichel, Wellington, New Zealand, assignor to Reichel Automatic Fire Alarm Co. Filed Dec. 22, 1908. Comprises a thermopile, a galvanometer arranged in circuit with the thermopile, a pointer therein, a



989,065.—LIFTING MAGNET AND BUCKET CONVEYOR.



989,259.—MERCURY ARC RECTIFIER.



989,292.—ARC LAMP.

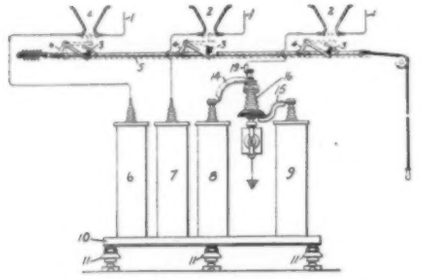
terminal mounted adjacent to the galvanometer pointer, a magnet near such terminal arranged to act on the pointer and a bell and battery arranged to directly complete circuit with the galvanometer pointer and the terminal.

989,458. ELECTRIC CIRCUIT BREAKER. William Walz, Toronto, Ontario, Canada. Filed March 6, 1909. An electric switch closing an electric circuit has a spring actuated to break the circuit, a spring-held latch mechanism holding the switch in its closed position, an electro-magnet included in the electric circuit and having a hollow core, an armature spindle extending through the core and an armature adjustably secured to the spindle.

989,462. REGULATING MECHANISM FOR INCUBATORS. Louis L. White, Eugene, Ore. Filed April 19, 1910. Thermostats are arranged to rotate a shaft in one direction or another with variations of temperature so that the opening between the hot-air chamber and the incubator is either closed or opened.

989,465. AUTOMATIC DISTRIBUTOR FOR ELECTRICITY. Harry Ashton Wolff, Chaville, France. Filed Dec. 31, 1910. Comprises a series of concentrically arranged contact rings and a rotary switch carrying a series of contacts one for each contact ring, in combination with a motor for rotating the rotary switch, a source of current supply, a series of working circuits each leading from a portion of one of the contact rings and having a common return, and a series of motor circuits each leading from a portion of another of the contact rings and having a common return.

989,487. LIGHTNING ARRESTER. Elmer E. F. Creighton, Schenectady, N. Y., assignor to General Electric Co. Filed Aug. 26, 1909. Two electrolytic arresters have their corresponding terminals electrically connected, a grounding switch being mount-



989,487.—LIGHTNING ARRESTER.

ed to co-operate with the other terminals of the arresters and thereby ground either one of the other terminals at will.

989,506. ELECTRIC CRANE AND DERRICK. John M. Kelley, Buffalo, N. Y. Filed June 17, 1909. A car traveling along an overhead track is provided with a winding drum, both car and drum being driven by electric motors.

989,516. FIRE-ALARM TELEGRAPH APPARATUS. Nathan H. Suren, Needham, Mass., assignor to Gamewell Fire-Alarm Telegraph Co., New York, N. Y. Filed April 12, 1909. Combines a plurality of main circuits, a plurality of main-relays controlled thereby, a repeating-circuit, a plurality of circuit-operating-devices operated by said main-relays, a plurality of switches controlling the operation of the repeating-circuit, and means, operated by any one of said relays, when active, for holding the switch of the active-relay closed and for opening the remaining switches.

989,518. ARC-LAMP. Samuel P. Wilbur, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Co. Filed June 2, 1905. Has a stationary electrode, a movable electrode, a sheath having a projection, and a clutch mechanism for the electrode, of opposing series and shunt magnet coils which govern the action of the clutch mechanism, and means dependent upon the engagement of the sheath projection with a portion of the clutch mechanism for cutting out the lamp.

989,521. GENERATOR-DRIVER. Harry C. Clay, Columbus, Ind., assignor to Reeves & Co., Columbus, Ind. Filed Oct. 19, 1910. A magneto has a shaft connected by a spring to a separate driving shaft so that the driving force is yieldably applied to the magneto.

989,527. AUTOMATIC TIME-SWITCH. Rudolph W. Lawson and Harry B. Snell, Denver, Colo., assignors of one-half to Fred W. Thompson, Denver, Colo. Filed Jan. 24, 1910. Combines a make-and-break device having a movable member mounted to reciprocate, spring-actuated lever arms positioned at the opposite ends of the movable member, cams mounted to rotate and arranged to act on the said arms whereby the latter are first operated to increase the tension of the actuating springs, means for rotating the cams, and clock mechanism connected to regulate the movement of the cams in synchronism with the clock mechanism.

989,532. MEANS FOR HOLDING AND CONVEYING AIR-TUBES AND ELECTRIC CONDUCTORS TO SUBMARINE DIVERS. Chester E. Macduffee, New York, N. Y., assignor of one-fifth each to George A. Traver, Brooklyn, N. Y., James P. Reid, New York, N. Y., John L. Gordon, West Hoboken, N. J., and Ernest Meyer, Tuxedo, N. Y. Filed Dec. 6, 1910. The electrical conductors are imbedded in the air supply and exhaust tubes.

989,549. FILAMENT-MOUNTING MACHINE. William R. Burrows, Newark, N. J., assignor to General Electric Co. Filed Dec. 29, 1906. Comprises a fixed support for a stem, a support arranged to hold the ends of a filament in contact with the wires in the stem, and means for automatically forcing an adhesive into place around the engaging ends of the wires and filaments.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired April 17, 1911:

518,213. INSULATING-TURNBUCKLE. Henry P. Ball, Schenectady, N. Y.

518,217. MEANS FOR EXCITING FIELD-MAGNETS OF ALTERNATING-CURRENT DYNAMOS. Louis Bell, Boston, Mass.

518,218. REGULATOR FOR DYNAMO-ELECTRIC MACHINES. Louis Bell, Boston, Mass.

518,221. ELECTRIC MOTOR CAR. Harold P. Brown, New York, N. Y.

518,231. ELECTRIC SWITCH. Axel Ekström, Lynn, Mass.

518,232. REGULATOR FOR DYNAMO-ELECTRIC MACHINES. William H. Elkins, Cambridge, Mass.

518,236. RHEOSTAT. Jonathan P. B. Fiske, Lynn, Mass.

518,244. CUT-OUT METER. Caryl D. Haskins, Lynn, Mass.

518,245. DAMPING DEVICE FOR ELECTRICAL MEASURING INSTRUMENTS. Frank Holden, Lynn, Mass.

518,263. TELEPHONIC APPARATUS. Charles Milde, Paris, France.

518,265. ELECTRIC MEASURING-INSTRUMENT FOR MULTIPHASE SYSTEMS. Edgar W. Mix, Lynn, Mass.

518,290. ARMATURE FOR DYNAMO-ELECTRIC MACHINES. Elihu Thomson, Swampscott, Mass.

518,291. MODE OF COOLING ELECTRIC MOTORS. Elihu Thomson, Swampscott, Mass.

518,293. ELECTRIC RAILWAY SYSTEM. Charles D. Tisdale, Boston, Mass.

518,297. ELECTRIC STOP MOTION. John Weir, Fall River, Mass.

518,310. UNIVERSAL-PHASE ALTERNATE-CURRENT MOTOR. Thomas Duncan, Fort Wayne, Ind.

518,311. ELECTRIC METER. Thomas Duncan, Fort Wayne, Ind.

518,312. ARMATURE. Ernst Egger and Ferdinand A. Wessel, New York, N. Y.

518,331. TELEPHONE-EXCHANGE SYSTEM. John I. Sabin and William Hampton, San Francisco, Cal.

518,332. TELEPHONE SYSTEM. John I. Sabin and William Hampton, San Francisco, Cal.

518,333 and 518,334. TELEPHONE EXCHANGE SYSTEM. John I. Sabin and William Hampton, San Francisco, Cal.

518,337. ELECTRIC TOWER-CLOCK. Charles D. Warner, Ansonia, Conn.

518,345. CONTROLLER FOR ELECTRIC MOTORS. William Cooper, Minneapolis, Minn.

518,349. REGULATOR FOR DYNAMO-ELECTRIC MACHINES. Charles L. F. Muller, Milwaukee, Wis.; Charles B. Carstens, administrator of said Muller, deceased.

518,359. ELECTRIC-CURRENT REGULATOR. Addison G. Waterhouse, Hartford, Conn.

518,360. METHOD OF REGULATING ELECTRIC CURRENTS. Addison G. Waterhouse, Hartford, Conn.

518,365. RHEOSTAT. Alva C. Dinkey, Allegheny County, Pa.

518,367. MULTIPLEX TELEPHONY. William W. Jacques, Newton, Mass.

518,392. TELEPHONE TRANSMITTER FROM SECONDARY BATTERIES. John J. Carty, New York, N. Y.

518,404. ELECTRIC STARTING SWITCH. Frederick V. Henshaw, Brooklyn, N. Y.

518,414. BOND FOR ELECTRIC RAILWAYS. Julius Meyer, New York, N. Y.

518,444. DYNAMO ELECTRIC MACHINE. Henry E. Dikeman, Berkeley, Cal.

518,463. COIN-CONTROLLED ELECTRIC MACHINE. Robert J. Merker, Cleveland, Ohio.

518,471. ELECTRIC SWITCH. Joseph B. Smith, Manchester, N. H.

518,481. ELECTRICAL CONTACT MECHANISM. John F. Blake, New Haven, Conn.

518,511. ELECTRIC RAILWAY SIGNAL. Benjamin F. Rex, St. Louis, Mo.

518,525. AUTOMATIC ELECTRIC SIGNALING DEVICE FOR CROSSINGS. Edward A. Hermann, St. Louis, Mo.

518,534. ELECTRIC CURRENT RECORDER. Johan W. Th. Olan, New York, N. Y.

518,540. ELECTRIC RAILWAY CONDUIT. Paul P. Banholzer, Philadelphia, Pa.

518,542. THERMO-ELECTRIC GENERATOR. Harry B. Cox, Hartford, Conn.

518,561. ELECTRIC MOTOR. Harold P. Brown, New York, N. Y.

518,562. ARMATURE FOR ELECTRIC MOTORS. Harold P. Brown, New York, N. Y.